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THE LAW OF  
VITAL TRANSFUSION  
AND THE  
PHENOMENON OF  
CONSCIOUSNESS

*By* CHARLES J. REED

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THE LAW OF  
VITAL TRANSFUSION  
AND THE  
PHENOMENON OF  
CONSCIOUSNESS;

AN ACCOUNT OF THE NECESSITY FOR AND PROBABLE  
ORIGIN OF THE DEVELOPMENT OF

SEX

AND OF THE DEVELOPMENT OF THE

CONSCIOUS STATE .

IN THE EVOLUTION OF THE ORGANIC WORLD, WITH  
A PRELIMINARY STATEMENT OF FUNDAMENTAL  
COSMICAL PRINCIPLES

By  
CHARLES J./REED

"No event ever happens more than once."—*Maxwell.*

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## PREFACE

It was intended to add a section on the *abiogenic evolution of protoplasmic irritability*, but the subject is complicated and difficult, though there appears to be a solution of the problem in endothermic chemical reaction, which it is hoped may be ready for publication within another year.

The author acknowledges with pleasure his appreciation of corrections by Dr. Geo. H. Boskowitz of San Francisco.

C. J. REED.

San Mateo, Cal., Sept. 7, 1921.

# THE LAW OF VITAL TRANSFUSION AND THE PHENOMENON OF CONSCIOUSNESS

## I.

### INTRODUCTION

TWO MEN stand with their faces toward the setting sun. One has the ordinary power of vision, the other is blind. To the one there appears a beautiful *phenomenon*, to the other, nothing. Both are facing the same juxtaposition of elements,—energy, matter, space and time, which constitutes the sunset sky. To the one there is a transfer of external relations through the organs of *vision* into correlative internal relations within the brain and the production within the brain of a *cognition* or *knowledge* of the external relations, which he is able to contemplate. He contemplates with wonder and admiration this cognition of changing color and form, and he calls it a beautiful phenomenon. His companion, facing the same juxtaposition of elements, receives no cognition, no knowledge of anything to admire or contemplate. The phenomenon is, therefore, not the combination of elements, but the *cognition* of this combination, the cognition produced within the brain of the individual through the organs of vision. To him who has no organs of vision there is no phenomenon, though the juxtaposition of elements is the same in both cases.

But if the blind man has only recently become blind and has previously had the vision of a sunset sky, then the words, "sunset sky," if mentioned by his companion, are transferred as an external relation through the organs of *hearing* into correlative internal relations within the brain, and there is then the production of a cognition, not of the external relations in this case, but a *cognition of a previous cognition*, that is, a re-cognition, recollection or memory of the cognition of a previous juxtaposition of elements of the same general nature, and he is able to contemplate anew the cognition of a former sunset.

If, however, this blind man has always been blind, has never had the cognition of a sunset sky, then there is no avenue through which the present external relations may transfer correlative internal relations, and there can be no previous cognitions of vision and, hence, no re-cognition. Such a person can have no conception of a sunset sky.

So with two persons seated in the auditorium of a grand opera, one having the ordinary power of hearing, the other being entirely deaf. There is on the stage another juxtaposition of elements, energy, matter, space and time. To the person who hears there is a transfer of external relations through the organs of hearing into correlative internal relations within the brain and the production within the brain of a cognition or knowledge of melody,—of external relations, which may be contemplated. To the other person there is no transfer of external into correlative internal relations and no sound, no phenomenon.

The word "phenomenon" is usually defined as an *appearance*, but it includes anything which appears or becomes known, not only through vision, but in any way. A thought or any cerebral act or state capable of cognition, capable of becoming known, is a phenomenon. The word is very often used to designate appearances, visual or otherwise, which are unusual or not well understood. The word, phenomenon, may perhaps be applied to a greater variety of subjects or objects, material and immaterial, than any other word in the language. But the *thing*, which we call the phenomenon, is not the real phenomenon. The real phenomenon is the cognition of the thing, not the thing itself—not the juxtaposition of elements. The elements themselves cannot reach the brain. Only the transferred relations of the elements reach the brain, and the brain can take cognizance only of what reaches it. When we speak of a gorgeously colored sunset sky as a beautiful phenomenon, we mean the cognition of this juxtaposition of elements. But we are obliged to use the same word to mean both the cognition and the cause of the cognition.

We place a telephone to the ear and recognize the voice of a friend, who is a thousand miles away. Though we have not heard that voice for years, there is no doubt as to the recognition. We recognize the voice, yet we do not hear the words spoken by our friend. The words are spoken in Denver and the voice is recognized in San Francisco, but the wire connecting these cities carries no sound. That long line of metal from end to end is as silent as the tomb of Pharaoh. It

transmits only impulses of electrical energy. The voice, the words which are recognized, originate in the brain of the one who hears in San Francisco. That voice is only a cognition produced in the brain of the hearer—a cognition of certain relations caused by energy transmitted from Denver to the brain of the hearer in San Francisco. And this transmission of energy and production of relations in the brain of the hearer is caused by correlative relations existing at Denver. The same is true of words spoken in the same room with the hearer, even spoken directly into the ear.

No external word, no external sound, ever reaches the brain. There is no *external* sound. The only sounds ever heard in any brain are cognitions originating and existing only in the brain—cognitions of internal relations in the brain produced by correlative external relations through energy transmitted to the brain through the ear and auditory nerve fibers. The ear and the auditory nerve fibers reaching from it to the brain are the counterpart, mechanically and functionally, of the telephone and the wire reaching from Denver to San Francisco.

This is also true of vision. We may truly say that what the eye sees is *not* what the eye sees, but what the brain takes cognition of within itself. All vision is cognition originating and existing only in the brain, cognition of internal relations produced in the brain by correlative external relations transmitting energy to the brain through the visual tract, that is, the eye and optic nerve-fibers. All sensations are purely physiological phenomena, cognitions produced by external relations transmitting energy to the brain through sensory tracts.

Our cognitions of the relations of physical elements constitute the sum of human knowledge. There are undoubtedly many relations and combinations, of which we have no cognitions, no knowledge. When some new instrument extends the range of our senses, so that we become cognizant of these combinations, we call them phenomena.

We appear to have no power of dealing with, of considering, discussing or even contemplating anything but cognitions. In a physical sense we may *handle* portions of the Universe. We may impress upon portions of the Universe the power of intelligence and will to produce or prevent changes of condition, but intellectually we are able to deal only with cognitions of successive states of the Universe or portions of it, not with the actual physical elements themselves. For example, through the exercise of intelligence and will we may cause the human



hand to manipulate a lever, which, through a suitable mechanism, will cause a revolving shaft to increase or decrease in its speed or rate of revolution. But we cannot *contemplate* either the shaft, its changes of speed or the mechanism. All we are able to contemplate is our cognitions of them, not the things themselves.

All cognitions exist in the brain only, but the external objects or influences which produce cognitions are located at the point of contact or irritation of the nerve with the external influence. For example, an injury to the finger, through a nerve-fiber extending from the point of injury to the brain, causes in the brain the cognition of the sensation of pain, but the cause of the cognition is located at the point of injury, the finger, and the brain locates the sensation at that point. The same is true of all cognitions of external happenings, that is, all cognitions of sensation. All other cognitions, such as memory, thought, desire, originate in the brain.

There are, therefore, two distinct kinds or classes of cognitions: those stimulated or produced by *external* relations transferred into correlative internal relations within the brain through the organs of sense, that is, cognitions originating in energy transmitted by the organs of sense; and those stimulated or produced by *internal* relations already existing within the brain, which are records of previous cognitions, that is, cognitions originating in memory. But all cognitions are phenomena of brain activity.

The cognition of a flame of burning gas is an example of a phenomenon, the result of a certain change *external to the brain*, but capable of cognition through correlative internal relations produced in the brain through the organs of sense and only through those organs. A thought, desire or any cerebral act, state or condition, is a phenomenon, the result of a certain change *within* the brain and capable of cognition without the intervention of organs of sense. The brain may act, think, or will when all sight, hearing and other sensation is cut off, provided the brain has previously received and recorded cognitions of sensation.

Consciousness is the cognition or knowing of existence—the existence of self and of the Universe. The word, consciousness, defines not only the cerebral act of self-cognition, but also a cerebral condition or state, in which the brain has the power of producing other and different cognitions simultaneously with the cognition of existence. We shall also frequently refer to consciousness as the conscious state.

## II.

## COSMICAL PRINCIPLES

The physical Universe presents itself to cognition or consciousness as a continuous succession of conditions produced by change. Change is everywhere and incessant. The sum total of human knowledge is knowledge of continuous change in the present and recollection or memory of change in the past. All supposed knowledge of the future is not knowledge. It is only inferential prediction. Because the sun rises today and rose yesterday, the day before and every past day of our lives, we infer and believe it will rise tomorrow, but we do not know and cannot know until tomorrow comes. Our study of the earth, the sun and the solar and sidereal systems convinces us beyond the possibility of doubt that the sun will rise tomorrow. But that conviction is not knowledge. It is only inferential prediction.

All that we can possibly know is that which IS and that which WAS. The future does not yet exist, and it is not possible to know that which does not exist and has not existed. With the same certainty that the sun will rise tomorrow we may predict that an eclipse of the moon will occur on a certain day two thousand years hence. But we do not absolutely know that the moon or the earth will exist two thousand years. Yet the conduct of our daily lives, everything we do of our own volition, is based entirely on inferential prediction of what will occur—prediction based on what has occurred.

What constitutes *change*? Change, as it is manifested through the organs of sense and interpreted by the power of cognition, consists in a difference between successive states of what we call the UNIVERSE.

We usually think of change as a change in *matter*. This is probably because matter, mass or substance is the *vehicle* through which sensation originates, though sensation is not actually produced by matter, but by energy. A change in matter may be a change in its position, in its form, in its condition or state, in its motion, in its temperature or in any of its properties.

Matter may undergo a change in *position* only by moving from one position to another. To do this it must acquire *motion*, must move through *space*, and must move during a certain interval of *time*. No change occurs instantly and no change in the *position* of matter can occur, except by *motion* in *space* during *time*.



Matter may undergo a change in *form* or configuration only when its parts or some of its parts change position with reference to other parts. Otherwise we cannot conceive any alteration of form. Therefore, any change of form in matter can result only from *motion of matter in space during time*.

The various other changes which have been observed in matter, whether they be change of state, temperature, motion or properties, have all been extensively investigated, and it has been found that in every case any change in matter is always the result of the action upon matter of *motion or something equivalent to motion*: that this action always takes place in *space* and during *time*. This *acting something*, which is equivalent to motion, has been called ENERGY. All motion of matter is energy and all forms of energy may be changed into and derived from the motion of matter, and matter in motion or undergoing any change, is matter acted upon by energy. This occurs only in *space* and *during time*.

Every change is, therefore, A PROCESS, IN WHICH ENERGY ACTS UPON MATTER IN SPACE DURING TIME. The most complicated change is nothing more and the simplest is nothing less.

ENERGY, MATTER, SPACE AND TIME, being necessary and sufficient for every change capable of cognition, constitute the physical elements of the Universe. The study of these elements and their relations to one another supplies a rational explanation, or at least affords a means of finding a rational explanation, for every observed phenomenon.

By a rational explanation is meant an account of the causes and effects concerned in a fact established or made known through the organs of sense, an account which involves no contradiction or double meaning of any of the terms employed and no contradiction of the observations of normal sense. By an "explanation" we do not mean an attempt to account for the origin, purpose or destiny of anything, but merely an attempt to state the relations of all of the causes and effects. No explanation of anything can do more. We do not even claim that a rational explanation is necessarily the statement of an absolute truth. An explanation may be entirely rational, as above defined, and may be entirely satisfactory with reference to and in accordance with the known facts, and yet, may later be found to be entirely erroneous. For example, in the Eighteenth Century the phlogistic theory of matter was entirely rational and stated in a highly satisfactory manner the relations of causes and effects as they were

then known. But that theory has now been entirely abandoned and shown to be impossible by the most overwhelming evidence. Nevertheless, in its time it was a rational explanation.

An *irrational* explanation is an account which involves some contradiction, explicit or implied, either of the terms employed or of the facts established through normal sense.

No rational explanation or account can be given of the origin of the Universe as such, nor of any part of it, because there can be no proof or evidence adduced, and, hence, no knowledge in reference to such questions. All attempts heretofore made to account for the origin or existence of the Universe involve such contradictions or ambiguities.

No rational account can be given of any phenomenon without previously accepting the existence of the physical universe as made known to consciousness through sense and cognition.

A theory based on a mathematical space of four dimensions, partly revived from past centuries, has been recently put forward, according to which there is no space, no time and possibly no energy or matter in existence, the only existence being "relativity." If we admit the truth of this theory for the present, in order to avoid wasting time in its discussion, we are still confronted with the same problem, the things which most impressively present themselves to consciousness, energy, matter, space and time. And it is the study of these, whether they exist or not, that is of interest to humanity.

A rational explanation of the origin of the Universe being impossible, the mind that contemplates such a task is appalled, and a weak, untrained or insincere mind may be driven into the irrational subterfuge of hiding behind the ambiguity of words, in order to avoid admitting that there is an *unknowable*.

He who would attain the attainable and know the knowable must first learn that there is also an unknowable, and must understand what distinguishes it from the knowable. The knowable is that which is, and this includes the record of that which WAS. WHY it is, WHENCE it is and WHITHER it finally leads are unknowable, because no evidence in reference to these questions can be adduced. The knowable is that, in reference to which evidence is possible. The unknowable is that, in reference to which evidence is impossible. By evidence we do not mean *testimony*. The testimony or statements of human beings is legal evidence of a fact, but not scientific evidence.

Scientific evidence is merely an assemblage of facts. The testimony or statement of a person, as to the existence of a fact, is sometimes accepted as scientific evidence, but always subject to verification. To accept a personal statement without question, as scientific evidence, is to be guided by authority or superstition, instead of reason.

The existence of the physical elements, ENERGY, MATTER, SPACE and TIME, being granted, a rational account of *established* facts after thorough investigation is not generally difficult. The proper understanding of these elements and their relations to one another, as a basis for the rational explanation of phenomena, requires that each element shall be defined in terms which admit of no ambiguity.

### III.

## THE PHYSICAL ELEMENTS

### DEFINITIONS

ENERGY is the physical element of *activity* or *motion*.

MATTER is the physical element of *mass*, *passivity* or *receptivity* of *action*.

SPACE is the physical element of *dimension*, *relativity* of *position* or *continuity* of *volume*.

TIME OR DURATION is the physical element of *relativity* of *succession* or *continuity* of *being*.

*Energy* and *Matter* are characterized by *mobility*, *mutability* and *heterogeneity*. They may be moved or transferred, may be altered in condition, form or state, and they are not uniformly distributed.

That matter may be moved or transferred from one position to another is one of the most obvious of the facts, which appeal to our senses or are comprehended by cognition; that it may undergo changes of form, state, temperature and properties, and that it is more dense in certain parts of space than in others, is almost as obvious. That energy accompanies matter in all of these changes, is not quite as evident, because the various forms of energy are more elusive than the forms of matter and do not affect the senses as easily in ways which

we have learned to distinguish and interpret. It will help to a clearer understanding, if we consider matter or mass merely as a *receptacle* for energy, and consider that we know matter only by the manner in which it is acted upon by energy; that we know energy only by the manner in which it acts upon matter.

*Space* and *Time* are characterized by *negativity*, that is, by *inactivity*, *impassivity*, *immobility*, *immutability*, *homogeneity* and *relativity*. Neither space nor time is capable of acting or being acted upon. Neither space nor time can be conceived to be moved, nor can either space or time be conceived to undergo any alteration of condition, form or state. One portion of space or time cannot be conceived to differ in density or quality from another portion.

Energy is characterized by the qualities of activity; matter, by the qualities of passivity; space and time, by the qualities of inactivity and impassivity.

The extent of space is infinite in every direction. We cannot conceive any limit to space in any direction. That is, we cannot conceive a place beyond which and in which there is no space.

Time or duration is of infinite extent in one direction or conception only, the *past*. In other directions or conceptions it has no dimension. This one dimension abruptly ends with and is always limited by the present. We know time or duration only by its single property or quality of uniform, continuous increment at the present.

The extent of matter may be infinite, but it may also be only finite. The farthest star or nebula visible to the telescopic eye is probably not the most remote body in the Universe, but it is the remotest of which we have any *positive* knowledge. We believe it is highly probable that there are other more remote bodies, but that belief is only inferential. If that belief is a mistake; if there is no other body beyond the range of the telescope—beyond the range of our present knowledge—then there is a limit to the quantity of matter. But this we do not know and are not likely to ever know. We do know, however, that either of these alternatives is conceivable. It is conceivable that there may be nothing but space beyond the visible Universe, but it is not credible. Therefore, we must leave unsettled the question as to whether matter is of finite or of infinite extent.

As to the extent of energy we have no more positive knowledge than as to the extent of matter. Energy is known only by its action upon and association with matter in space during time. Matter is



known only by the various ways in which it is acted upon by energy. We cannot conceive energy as acting upon or moving itself. We cannot conceive energy as acting upon or moving either space or time. Therefore, energy can be conceived as acting only in connection with matter. If matter be of only finite extent, then energy is also probably of only finite extent, since energy can be conceived to exist only in association with matter. We shall see later that the total energy of the Universe may be considered as the total separation of particles of matter from a single mathematical point, which must be the center of gravity of the Universe. That matter might exist unassociated with energy is a possible conception. We may *conceive* of a single, isolated particle of matter existing in space without attraction, without motion, without heat, without any form of energy. But the existence of two or more particles of matter in separated positions in space during time implies the possibility of these particles moving toward each other through space, which means the power of producing motion of matter in space during time, which is energy.

Matter, energy and space are the three physical elements, which may be considered as having a persistent existence or *entity*; a being of persistent, *unaltered* quantity existing through successive states of duration. Time, as a physical element, is not an entity and has not at any instant a being of unaltered quantity. The only conception we can have of time is that of uniform and continuous *increment* or growth. It is more like a quality or property asserted of the Universe as a whole, the quality of *relativity of succession*.

By the cognition of successive states of the Universe or portions of it, that is, by the cognition of changes, we become aware of the increment or growth of time, and this is the only property through which it is known. By arbitrarily assuming the similarity of certain successive events we obtain a unit of measurement for the growth of time. It is usual to assume that the successive vibrations of a pendulum of fixed length vibrating on a line fixed with reference to the earth, are similar events and that they measure equal increments of time.

## IV.

## AXIOMS

1. When there is no evidence that an event has occurred, the presumption that it has not occurred is warranted.
2. The simultaneous occurrence of several events is not evidence that one of the events causes or is caused by another. Otherwise each event must necessarily cause and be caused by all of the others.
3. When there is no evidence of the existence of a thing, the presumption that it does not exist is warranted.

## V.

## FORCE

All bodies at all times are in certain conditions of stress or tension, in virtue of which they tend to undergo change. For example, all bodies with which we are acquainted tend to move toward the earth's center. We say they exert a pressure, stress or weight in that direction. This *effort* we call the *attraction* of *gravity*. All such efforts are called *forces*, whether they are efforts of attraction, repulsion, stress, tension or pressure of any kind. All forces are merely the efforts or tendencies of energy and matter to undergo transformation or change, and they are all *generated* by the action of energy on matter in space during time.

Energy and matter are the only physical elements subject to effort or force. This is in virtue of their mobility, mutability and heterogeneity and in virtue of the activity of energy and the passivity of matter. Space and time, on account of their inactivity, impassivity, immobility, immutability and homogeneity, cannot be subject to any effort or any kind of transformation.

The force of gravitation may be taken as an illustration of the general nature of forces. The force or attraction of gravity is the effort of all bodies to move toward the earth's center. We commonly think of the force of gravitation as extending *equally in all directions*

from the center of a body, such as the center of the earth or the center of an atom. While this statement may be actually true in a particular case, it is not a correct statement of a general truth. It is hardly possible that it could be true in any particular case and could only be true when there is a distribution of matter equally in all directions. Such a condition is difficult to conceive.

We have no evidence whatever of the existence of any force of gravitation extending from the earth's center or from any other point in space, *except in lines extending to particles of matter*. In other words, gravitation is an attractive force or effort exerted only between portions of matter and not radiating uniformly through space. A correct statement of the principle of gravitation would be that it is an attractive effort between particles of matter, the intensity of which is independent of direction in space and dependent only upon masses and distances. It is evident that no force could be dependent upon direction in space. Otherwise, space could not be homogeneous.

The gravitational effort of any body or system of particles toward any external particle or system is the same as though its particles were all concentrated at a single point called its center of gravity. It is evident that there can be no gravitational or other attractive effort between two or more centers of gravity located at the same point, as, for example, between the centers of concentric spheres. Between such centers we have no evidence of the existence of any attraction of gravitation.

Let us assume two such concentric spheres to be, one the earth, and the other a small sphere of metal having the same density as the earth and located at the earth's center. Let us assume further that the earth, or the central portion of it, is a sphere of liquid, in which the smaller sphere of metal is free to move *without frictional resistance*. In this concentric position the sphere of metal has no weight, no effort of motion, no pressure. It is not affected by any attraction of gravity or any force or stress and it cannot of itself originate any motion. Let us now apply to this sphere of metal a certain quantity of energy of motion from an external source by causing a second sphere moving in space to impinge against it with a certain velocity. The center of the sphere of metal now begins to move away from the center of the earth with a certain velocity and with a certain quantity of acquired energy of motion, energy acquired from the external source, the impinging sphere. Simultaneously this motion of separation of the metal

sphere from the earth's center *generates an opposing effort*, which is exerted against the motion of the metal sphere, tending to make it fall back again to the earth's center. That is, the act of separation *generates a gravitational attraction* between the center of the earth and the center of the sphere. This *generated* gravitational attraction, acting between the center of the metal sphere and the earth, retards and finally overcomes the motion of separation, thereby converting the energy of motion completely into potential energy of separation or energy of position. The position of the metal sphere with reference to the earth's center becomes stationary, but the generated gravitational attraction continues to act, and after an infinitesimal interval of rest the sphere begins to move back again toward the earth's center. The energy of position is now changing back into energy of motion as the sphere again approaches the earth's center. The gravitational effort continues to act while the sphere is moving—though with diminishing intensity—and this continuous action causes a continuous increase or acceleration in the velocity. When the metal sphere, through this acquired energy of motion, again reaches the earth's center, it no longer has any energy of position and there is no longer any gravitational attraction between the sphere and the earth's center. But in losing its energy of position the sphere has acquired again the equivalent in energy of motion, and has acquired a velocity and an energy of motion exactly equal to that originally imparted to it from the external source.

If we now leave these bodies to themselves, this cycle of changes will be repeated an indefinite number of times, that is, will become periodic, the metal sphere swinging back and forth through the earth's center like a pendulum. In all of these changes the total quantity of matter remains unchanged and the total quantity of energy remains unchanged and equal to the energy of motion originally imparted to the metal sphere from the external source. But the gravitational attraction is continually changing in intensity, increasing periodically from zero and again diminishing to zero. And it is evident that this varying force, passing alternately into and out of existence, is not a being of persistent, unaltered quantity, and is not a physical element, but merely the effort of energy and matter to undergo change—an effort generated by energy acting on matter in space during time, and depending upon the quantity of separation produced.



If in the above illustration we assume the earth to have an interior, spherical, concentric, vacuous cavity, instead of being filled with solid, liquid, or gaseous matter, the changes would be somewhat different. In that case the metal sphere within the hollow cavity, whether located at the center or elsewhere, would not be acted upon by any gravitational effort. If under these conditions the metal sphere, located at the center of the cavity, were to receive motion from an external impinging body, it would, as before, move away from the center with a velocity corresponding to its acquired energy. But in this case it would generate no gravitational effort and would have no tendency to return to the earth's center. Its velocity, instead of being retarded by a gravitational effort or attraction, would remain uniform until it reached the interior surface or wall of the cavity. Let us assume further that this interior surface is the surface of a solid having perfect elasticity. On striking this wall the metal sphere immediately begins to compress the elastic body and simultaneously begins to generate a retarding effort, rapidly reducing the velocity of the sphere to zero and changing all of its energy of motion into energy of position, or potential energy, by displacing the particles of the elastic wall. The elastic force or effort thus generated continues to act on the metal sphere and causes it now after an infinitesimal period of rest to move in the opposite direction toward the earth's center. When the potential energy stored in the elastic wall has all been re-impacted to the sphere as it leaves the elastic body, the sphere will have acquired a velocity in the opposite direction toward the center equal to its former velocity away from the center. It will then continue to move with this uniform velocity back through the earth's center and to the opposite side of the cavity, from which it will again rebound with the same velocity, and indefinitely continue to make equal periodic vibrations across the empty cavity. But the character of its motion and the changes of energy will, as above explained, be entirely different from those of the previous case. In the latter case gravitation is in no way involved at any time. The metal sphere, while moving across this cavity with uniform velocity, is in exactly the same condition as though it were moving in infinite space in which there was no other particle of matter and no attraction of gravitation. The reason for this is that, in moving across this empty space with uniform velocity, the metal sphere is neither receiving, giving up, nor transforming any energy. That is, external energy is

not acting on the sphere during its motion across the empty cavity, its motion being due entirely to its acquired kinetic energy and not to the continuous application of energy. A body moving with uniform velocity in empty space would require no additional energy to keep it moving. In this illustration it will be noted that the earth has no center of gravity with reference to the metal sphere, because the metal sphere is not an *external* particle or system. This illustration would be strictly correct, if the earth were perfectly spherical and the shell of uniform thickness and density, but not otherwise.

The force exerted by a compressed mass of gas or a compressed spring is of similar nature, though governed by different laws of variation. All forces may be shown to be merely the effort of energy and matter to undergo change, and may be shown to be produced by energy acting on matter in space during time.

We may, therefore, define *force* as the effort of matter to return to a condition, from which it has been displaced by the action of energy in space during time. It is not our purpose to go deeply into the details of physical forces, and the above is given only for the purpose of illustrating the general nature of force and making clear the difference between force and a physical element. We may speak of the laws of gravitation as immutable laws, meaning the laws governing the variation and the results of gravity, but it would be very erroneous to consider gravitation itself, or any force, immutable.

If all matter were concentrated at a single point in space without heat, there could be no energy, no attraction, no force; and the present total separation of the material particles of the Universe may be taken as a measure of the total existing energy.

Gravitation is not to be considered as an attraction existing as such and radiating into space, but only as the effort of particles of matter to return to a single mathematical point, from which they have all been displaced by energy.

If all matter could be conceived to condense to a single mathematical point, which occupies no space and again to evolve from that point, energy must be considered to simultaneously condense and evolve in causing that change. After such condensation and prior to the re-evolution neither matter nor energy could exist.

It is the heterogeneity of matter and energy and the changes they undergo, which makes possible the cognition of the relation of a preceding to a succeeding event or state and, hence, makes possible the

cognition of duration. Therefore, if we could conceive matter to condense to a mathematical point occupying no space, not only matter, but also energy and time, or the succession of events, must simultaneously cease to exist. But our only cognition of the relativity of position or space is of that which exists between portions of matter or portions of energy. Hence, space would also simultaneously cease to exist. In other words, with the condensation of matter to a mathematical point, the Universe would cease to exist, and with the evolution of matter from a mathematical point, the Universe would necessarily come into existence. But these imaginary speculations are based on the hypothesis of conditions which we cannot conceive. Yet, many of our fundamental empirical chemical and physical laws are based on the conjecture that all gaseous matter by reduction of temperature condenses toward a mathematical point, which is reached by extrapolation at a temperature of 273 degrees below zero, Centigrade.

There is another viewpoint of force and energy which must not be overlooked. Every change, every transformation of energy and matter results from an effort or force and results in the exhaustion of the effort and the generation of another effort. It might be possible to change our fundamental conceptions and assumptions entirely and build a new system of physical science on these facts. We might assume that force or effort is the physical element, instead of energy; that in every change force is converted from one form of effort into another and that energy passes into and out of existence, instead of force.

For example, a body resting on an elevated support has potential energy. It also has an effort to move toward the earth's center. Its potential energy is due to that effort, which has been generated by lifting the body into its elevated position against that effort. When we remove the support, the body moves under the influence of the effort and loses its potential energy, but simultaneously acquires kinetic energy. Instead of saying it acquires kinetic energy, we might say it acquires an effort to continue its downward motion and that its energy disappears. As the body moves downward and reaches the center of the earth, it loses all of its potential energy and all of its effort in that direction. But it has now acquired an effort to continue in motion. And it is not easy to distinguish between kinetic energy and the effort of a moving body to continue in motion. Either of these expressions would be a definition of the other. Nor is it easy



to distinguish between potential energy and the effort of a body to move toward the earth's center.

If we interrupt the motion of a body at any point by interposing an elastic body in its path, the effort to continue in motion will be overcome by compressing the elastic body. This compression generates an effort to move in the opposite direction. In this way we might trace the loss of one effort into the generating of a succeeding effort. In each case there is also a disappearance of a portion of energy and the generation of another portion.

## VI.

### THE PROVINCE OF MATHEMATICS

Mathematics is the science of quantity or number—the measuring stick of the Universe. It provides methods of measuring the physical elements, the various forms of force and all elemental and dynamic relations. It comprises systems of rules and formulæ deduced by the cerebral act of cognition or reason from fundamental assumptions in reference to space and time, particularly space.

No physical element, however, in either its properties or its essential nature, is in any way dependent upon or connected with mathematics or any mathematical formula or deduction.

There is no limit to the possible number of deducible mathematical formulæ. It is, therefore, not surprising that out of this infinite number some have been found which approximately, or even perfectly, express elemental relations. These coincidences, when they are found, are always useful and convenient in supplying easily remembered and easily handled statements of the particular relations and in aiding the discovery of additional relations. But these coincidences, however useful and important they may be, afford no grounds for the assumption that there is any connection, even in the remotest degree, between any elemental or dynamic relation and any mathematical formula: or that our cognitions of an element or an elemental relation are either correct or incorrect on account of conformity or non-conformity with any mathematical deduction. A physical element of the Universe

could not be in any way dependent upon or connected with the product of a cerebral act. For example, it would be a most unwarranted proceeding to assume or to state that space or time or energy or matter does not exist, merely because a certain mathematical deduction expresses such a relation. Could anything be more ridiculous than a statement that the existence or non-existence of infinite space depends upon whether a certain mathematical expression has a plus or a minus sign?

We have cognitions that energy, matter, space and time all exist as parts of the Universe. These cognitions come from the elements themselves and cannot be eliminated by mathematical deduction.

In very recent times those who take great delight in pure mathematical abstraction have unduly magnified the relative importance of mathematics and have come to the belief that, where there is a discrepancy between an elemental relation and some approximately correct mathematical expression of the relation, the elemental relation must be bent or distorted by additional hypotheses and assumptions to make it conform exactly to that mathematical expression. In this manner the measuring stick has assumed an attitude of greater importance than the thing it is to measure. For example, the mathematician has recently invaded the chemical laboratory and is trying to supplant the analytical balance by the mathematical formula. The purpose of the mathematical chemist is not to find a mathematical expression for chemical facts established by the balance, or to establish new chemical facts, but to find a chemical relation which will closely correspond to some assumed mathematical expression, and then, by innumerable auxiliary assumptions, try to bend other chemical relations into conformity with the same expression, even ignoring important and well established facts. And it is conceivable that, by making a sufficiently great number of assumptions, all chemical relations might be made to conform approximately to *any* mathematical expression. But it is not clear that this would materially extend the range of chemical knowledge.

## VII.

## BODIES

We seldom have occasion to deal with or even contemplate the Universe as a whole. We deal with certain definite and more or less isolated portions of it, either separately or in conjunction with one another. These definite portions we call *bodies*.

A body is generally spoken of as "a portion of matter," but this definition is not sufficient for our purpose. For our purpose the term, body, includes, not only the matter or mass, but the energy acting upon it, the space it occupies and the time of its existence as a definite body. A body is, therefore, a portion of the Universe consisting of a portion of matter acted upon by a portion of energy, occupying a portion of space and maintaining certain conditions and undergoing certain changes of condition during a certain interval of time.

The properties of a body depend upon the relations between the matter-constituent; energy-constituent, space-constituent and time-constituent, of which it is composed. For the purpose of illustration let us consider briefly a few examples of different kinds of bodies, and the changes which may convert them into other bodies.

Example 1, *a piece of sulphur*. In its liberation of heat or absorption of heat in undergoing combination or changing state a piece of sulphur presents the qualities of activity, motion or energy. In its aggregation of minute particles or atoms always attracted toward the center of the earth it presents the qualities of passivity, mass or matter.

Example 2, *an incandescent lamp filament*. The carbon or tungsten filament in the globe of an incandescent lamp is a body, which, during a certain time, may have the properties of a cold, non-luminous solid. If, during a subsequent time, an electric current of a certain strength should pass through the filament, it would acquire the properties of a heated and luminous solid. It would become a different body, though the matter-constituent remains the same. The energy-constituent, the space-constituent and the time-constituent have changed. The body could not be luminous and non-luminous at the same time and it could not be in the same condition with and without the energy of the electric current. The space it occupies while the electric current is passing is different from the space it occupies when no current is passing.

Example 3, *an electro-magnet*. An electro-magnet is a body commonly comprising an iron cylinder surrounded by an insulated copper wire, through which an electric current is passing. It has certain properties, one of which is the power of attracting iron. If we interrupt the electric current, it is no longer an electro-magnet, and does not attract iron, though it is still a body and still has the same matter-constituent. It is now, however, an entirely different body and has different properties, because its matter-constituent is now, at a different time, acted upon by a different energy-constituent. Changing either the matter-constituent or the energy-constituent of a body changes the body and alters its properties, but changing only the space-constituent may or may not change the properties. We may change the space-constituent of a body by moving it horizontally in a straight line without altering its properties, but if we change the space-constituent of a rock by reducing it to powder or breaking it into fragments, we alter its properties. A change in the time-constituent alone cannot alter the properties of a body. That is, continuity of being cannot of itself produce any other change in a body.

Example 4, *a pound of ice, water or steam*. The same portion of matter may exist successively in a pound of ice, a pound of water and a pound of steam, all three of which are different bodies, though they are identical in their matter-constituent. They differ greatly in the amount of energy they contain, in the volume of space they occupy and in the time of their existence. The same matter-constituent or the same energy-constituent, could not at the same time be in the ice, water and steam.

We are accustomed to consider a body merely as a portion of matter, because the matter-constituent is most easily perceptible, but it is evident that the properties of all bodies depend as much upon the energy-constituent as upon the matter-constituent.

Example 5, *a living animal or plant*. A living animal is a body in which we find the most complex and unstable relations between the matter-constituent and the energy-constituent. So unstable are these relations in this class of bodies, that continuous transformation, with continuous liberation and dissipation of energy is the most essential and one of the distinguishing properties of living animals. A living plant is also a body, in which the relations between the matter-constituent and the energy-constituent are complex and unstable, but much less so than in animals.

## VIII.

## LIVING AND LIFELESS BODIES

For our present purpose it will be necessary to distinguish clearly between two classes of bodies, *living* and *lifeless*. When we speak of "living matter" we mean the matter-constituent of a living body. If we use the term, matter, in the sense of matter-constituent, we may also correctly speak of "organic matter," meaning the matter-constituent of certain bodies, which had their origin in previous living bodies. We must not, however, confuse the term, organic, with the term, living. A body may be organic and at the same time lifeless, but could not be living and inorganic, though it possessed no organs.

## LIFELESS BODIES

Lifeless bodies are distinguished by the following properties:

1. A tendency to acquire and finally maintain homogeneity of structure.
2. A tendency to acquire and finally to maintain homogeneity of chemical composition.
3. A tendency to acquire and finally maintain simple and permanent relations between the matter-constituent and the energy-constituent.

## LIVING BODIES

Living bodies are distinguished by the following properties:

1. Complex and temporary relations between the matter-constituent and the energy-constituent.
2. Heterogeneity and complexity of structure and composition.
3. Always containing a large percentage of water and of carbon as necessary components.
4. Existing only within a small range of temperatures.
5. Existing only as solid bodies containing liquids, the solid portions always originating in the liquid.
6. Possessing the INVOLUNTARY VITAL FUNCTION of automatic growth, generation or propagation, or the power of changing and incorporating external bodies into the living body itself and building up complex and unstable compounds from simpler and more permanent bodies.



7. Continuous chemical reaction accompanied by absorption and dissipation of energy.

8. Continuous change of both matter-constituent and energy-constituent.

9. Dissolution, or the spontaneous, unavoidable breaking-up and destruction of the individual body after a certain period of activity.

In addition to the above-named characteristics, which may be considered universal, there are certain other characteristics, which belong exclusively to some living bodies, but are not known to exist in all living bodies. Among these may be mentioned—

1. A circulating or moving liquid within the body, which is propelled through the body and acts as a carrier or means of transportation of material.

2. Retention during life and transmission to offspring of an individual or specific personality, which persists through complete changes of the energy-, matter-, time-, and space-constituents.

3. The power of originating and controlling motion and changes of motion.

4. Individual generation, propagation or reproduction of isolated masses of a specific and determinate form, which, under uniform conditions, is persistent through successive generations.

5. The PHENOMENON OF CONSCIOUSNESS or knowledge of the existence of self and of the Universe.

Living bodies may be classified in various ways, depending on the purpose under consideration. But no system of classification enables us to absolutely define the distinguishing characteristics in such a way as to include every species and variety. The usual method of classification is to divide living bodies into two general classes, animal and vegetable; but there are species which possess some of the characters of both and not all of the characters of either.

The simplest and lowest form of living body is the amoeba, which is merely a membranous cell or sack containing living, formless fluid. It has more of the characteristics of animal than of vegetable life, yet is lower and simpler in the scale or organic structure than vegetable structures. It has the powers of locomotion and "irritability." Most plants have the power of slight movement, but not locomotion, being generally rooted in a fixed position. Animals, as a rule, have the power of free locomotion. In the case of the amoeba the organic structure consists of only a single cell or sack filled with protoplasm.

In all living bodies more highly organized than the protozoa the organic structure or body consists of a multiplicity of cells, forming one or more tissues or cellular fabrics containing a fluid plasma. The cells constitute retaining walls for the liquid. The liquid always contains albuminoids, a material capable of undergoing a spontaneous chemical change and hardening into additional retaining wall. This cell-wall or membrane, composed of hardened material from the liquid itself, in animal structures is *fibrin*, in vegetable structures, *cellulose*. This hardening or solidifying of liquid material is the origin of all organic structures without exception. In the liquid state any kind of material may be transported to a great height by capillary attraction through a porous or cellular body to any position, where it may be needed to form or extend the solid structure.

When a living, growing cell, through this process of hardening of material contained in the liquid, attains a certain growth or age, a partition forms across the interior of the cell, producing two cells, each containing the liquid. A repetition and continuation of this process produces a cellular tissue or solid structure built up of a multiplicity of cells, all filled with the liquid. The membranous walls of these cells are permeable to the liquid or to certain constituents of the liquid. If the wall is permeable to the entire liquid, the resulting structure will be uniform and composed of similar cells. But if the walls of certain cells, such as the outside layer, become subject to an additional hardening process, they may become less permeable to certain constituents of the liquid. This would result in a different liquid in these cells and the development of a different kind of cell-wall and the formation of a different kind of tissue..

An organic cellular structure produced by the multiplication of similar cells through partition is uniform as to kind and quality.

When a semi-permeable cell-wall allows certain constituents only of the contained liquid to pass out, these constituents form on the opposite side of the cell-wall and in the adjacent cell a different liquid, which produces a cellular tissue different from the first, causing the growth of two different kinds of tissue in contact. By this and similar processes we may account for all of the various kinds of tissues found in the bodies of animals. In vegetable structures there are only a comparatively few different kinds of tissues formed in a single body. One of the reasons for this is that the liquid or blood

in vegetable organisms is comparatively simple, and cannot differentiate by diffusion through semi-permeable walls into a great number of different kinds of liquids. But these vegetable tissues, though few in number, may grow to enormous size, often extending hundreds of feet in height.

The solution or blood is always derived from without by absorption through the cellular walls at available points and is then transported throughout the system. The same is true also of all animals. The constituents of the blood are always obtained by absorption in the liquid state through the membranous wall of a cell. The food of animals is in most cases placed in an internal cavity called the alimentary canal, where the useful portion is converted into a solution. Various constituents of this solution are absorbed in different parts of the apparatus and are then transported in liquid form to wherever needed.

All of these changes and processes take place in accordance with the well established laws of chemistry and physics, and when we shall find the cause which produces the automatic division and multiplication of the organic cell and the cause of the automatic hardening of the liquid constituents into the solid membrane, we shall be very near to the key which unlocks the "mystery of life."

When a living body ceases to live it tends to disintegrate. The complex structure tends to break up into simpler and smaller portions. The complex and unstable chemical compounds break up into simpler and more permanent compounds. This process goes on until all structures and compounds have become so simple that there is no further tendency to change and the permanent stage of lifeless bodies is reached.

Every living body is a machine working on purely mechanical principles, generally built up of various, and usually numerous, organs or instruments, each performing its own special function for the use and support of all of the others, each depending more or less upon all of the others. The entire mechanism works continuously, automatically and independent of any external power, but either continuously or at intervals receives matter and energy from external sources and converts them into growth and renewal parts of its own mechanism.

Every living body develops either from a single protoplasmic cell or from a portion of a pre-existing living body by a process of auto-

matic growth, division and differentiation, thereby building up complicated chemical compounds and organic tissues in accordance with its own needs. These processes take place and the produced organs function without the exercise or necessity of any guiding intelligence, will or conscious act. On the contrary, the phenomena of intelligence, will and consciousness, instead of being the cause of these processes and organic developments, are always the result or product of the organic processes.

A living body may cease to live and live again after a period of lifelessness, provided we speak of the body in the two cases only in the sense of *approximate identity*.

All living bodies during the period of life are continuously and rapidly changing progressively toward death, and in passing from infancy to old age and decrepitude generally undergo an entire replacement of their energy-, matter-, time-, and space-constituents, accompanied by a succession of alterations, which destroy all resemblance between the earlier and later stages. Yet each body retains or inherits during all of these changes a continuity of properties, which enables us to identify it as the same individual, though not the same body, in all of its stages.

A living body with its complicated system of organs is also properly called an *organic* body. It is also spoken of as organic immediately after death ensues and before disintegration has occurred, though disintegration may be arrested for an indefinite period.

The study of living bodies has resulted in the generalization that the highest order of development corresponds with the greatest variety and complication of interdependent organs.

Every living body, before it approaches the end of its period of activity, or life, tends to transmit a reduplication of its own body as it existed in infancy. The seed of every plant or tree, the egg of every animal, contains a reduplication of the previous form, either developed or having the potentiality of development. This reproduction is merely the transmission of the *involuntary vital function* from an old matter-constituent and an old energy-constituent to a new matter-constituent and a new energy-constituent.

In sharp contrast with and distinction from all of this the lifeless body has none of the above-mentioned properties. Instead of the tendency toward continuous alteration in the building up of a heterogeneous system of tissues and organs, composed of complex and un-



stable compounds, and instead of the continuous replacement of the matter- and the energy-constituents, the lifeless body tends to acquire, and having acquired, tends to maintain permanent simplicity and homogeneity of structure and composition, devoid of tissues, organs and multiform dissimilar parts.

In the crystal of rock, of sulphur or of diamond; in the cube, the block or the sheet of ordinary metal, we find no differentiation of parts. Each molecule of the mass, as far as we are able to distinguish, is like every other molecule in the mass. The density, hardness and other properties show uniformity and permanence. The trunk or leaves of a dead tree and the remains of a dead animal are examples of lifeless bodies which have not acquired the stage of permanence, simplicity and homogeneity. But lifeless bodies of this type, which originate in previous living bodies, tend to disintegrate at once and become resolved into other bodies of simple, homogeneous and permanent properties.

All living bodies and all lifeless bodies which are the remains of immediately preceding living bodies, are made up of chemical compounds of oxygen, hydrogen, carbon, sulphur, nitrogen, phosphorus, calcium and a few other elements. These compounds are of complex composition and molecular structure.

They consist chiefly of starch, sugar, cellulose, albumen and fibrin, the latter two being of variable and extremely complex composition.

Fibrin may be considered as solidified albumen and albumen, as liquefied fibrin, there being no clearly marked distinction between them in chemical composition. Muscle, which constitutes a large part of the bodies of animals, is chiefly fibrin. The mere mixture of two different albumens, both having the same chemical composition, will often precipitate a coagulum of solid albumen, which also has the same composition. This peculiar property of the albumens may be a very important factor in the formation of fibrinous structures. For example, if two different albumens, located on opposite sides of a protoplasmic cell, should pass by diffusion through the cell-wall and come in contact along a central or other interior plane of the cell, there could be formed along that plane a solid albuminous or fibrinous wall or partition extending across the cell and dividing it into two cells.

The venom of the rattlesnake is an albumen having the same composition as the albumen in the human blood, and the venomous char-

acter of this deadly poison depends upon the fact that, when it is injected into the blood, it causes the albumen of the blood to coagulate or solidify.

The protoplasmic cell has the power of converting carbon dioxide and water into the above-mentioned and various other carbo-hydrates. This is a process of storing up energy in the form of chemical potential energy and takes place only through the absorption of energy from without. It takes place in the protoplasmic cell by absorbing energy in the form of heat and light, and particularly in the presence of certain substances, such as chlorophyll.

## IX.

### THE INVOLUNTARY VITAL FUNCTION

The involuntary vital function may be defined as the power which keeps in operation continuously from birth until death the processes of growth and multiplication of the plasmatic cells, that is, the growth of cellular structures and tissues; maintains the circulation of the plasmatic fluid or blood; causes the solution and assimilation of foreign material and its conversion into necessary, complex *organic* chemical compounds. This power is contemporaneous with the life of the body, is inherited from the parent and transmitted to the offspring without interruption. It is in no way dependent upon, connected with or governed by either volition or any kind of cognition or conscious state.

*Life* may, therefore, be defined as *the period of activity of the involuntary vital function*.

But the involuntary vital function may also exist in potentiality and not in activity. The seed of a plant may exist for ages in absolutely lifeless inactivity, undergoing no change in its matter- or energy-constituents. But whenever the seed is subjected to the proper environment, this potentiality changes to activity and the body begins to live and thenceforth to undergo the continuous changes of all living bodies. Under certain conditions the activity or life may be interrupted and the potentiality restored, provided disintegration does not begin.

The involuntary vital function is in activity during the development of a seed in the flower of a plant. When the seed has fully developed the vital activity within it ceases. The seed dries out, becomes lifeless and is cast off, carrying with it only the potentiality of coming into life again.

Living fishes have been subjected to the extreme cold of liquid air until they were frozen into solid, crystalline masses as lifeless and permanent as any crystal of rock. In this condition they might have remained for centuries, absolutely lifeless, yet retaining the potentiality of the involuntary vital function. When these fishes were subjected to the proper temperature and environment, this potentiality assumed a new activity and a new life began, which could not be distinguished from the former life. This was possible only because in the processes of freezing and thawing there were no destructive changes in the body, and in the frozen state there was no change in either the matter- or the energy-constituent of the body, and because the involuntary vital function and its potentiality are in no way dependent upon the time-constituent or the space-constituent.

A kidney, one of the vital animal organs, was removed from the living body of a dog and preserved from decomposition for the period of a week or more in an absolutely lifeless condition, there being no activity of the vital function. After this period of lifelessness the kidney was replaced in the body of the living dog and a new life was brought into it, the dog having later lived for several years after the removal of the other kidney. There are many instances of dismembered parts of a living body having been restored to vital activity after becoming lifeless. All of these facts show beyond question that a living body may become lifeless and live again.

## X.

## THE POWER OF REPRODUCTION

The power of reproduction is the power of extending and transferring the involuntary vital function or living condition. When a protoplasmic cell enlarges and finally divides into two cells by the formation of an internal wall or partition, each of the cells thus formed inherits the involuntary vital function of the original single cell, and in this manner the vital function is extended to an entire tissue or structure as it is built up by this multiplication of cells. This is *reproduction by extension* or growth and is the fundamental method of extending and transmitting the vital function or *life*.

When a seed or egg, containing a potential living body, is cast off from a pre-existing living body and becomes a separate individual, the potentiality of the vital function is already contained within the separated individual, it having been derived before separation from the original or parent living body through adhering tissues, which have been brought in contact, but have not actually united and are always separable again along the cleavage surface of adhesion. This is *reproduction by transplantation and transfusion*.

There are at least these two kinds of reproduction, the *continuous*, or reproduction by extension of the individual, and the *parasitic*, or reproduction by the formation of new and separable individuals through the development of a transplanted cell or tissue, which derives the alimentation of development from the pre-developed individual, upon which it is transplanted as a parasite, by the transfusion of nutriment through the surfaces of the adhering membranes, along which it again finally separates.

In the growth of the stem or branch of a tree we have an example of reproduction by extension, and in the production of a seed, egg or living-born animal we have an example of reproduction by transplantation and transfusion. In the former case the reproduced or extended growth continues to form a part of the original and never becomes detached, though the original may die away at the old end, while at the new end the growth and extension continue. Or the body of the plant may be accidentally divided into parts, each part becoming a separate individual. In this reproduction by extension the involuntary vital function is transmitted without interruption to an



additional portion of the same tissue, which does not leave the parent body.

In reproduction by transplantation and transfusion, as that of a seed, egg or living-born animal, the involuntary vital function, with its individual and specific or racial tendencies is transferred from one living tissue by transfusion to an adhering cell or tissue transplanted upon it from another living individual of the same or nearly similar species, or from a different part of the same individual, the transplanted cell or tissue deriving its subsequent alimentation, growth and development from this transfused nutrition, at the same time maintaining its separate identity and finally separating as a separate individual.

The transplantation of a living cell or portion of tissue from a separate source or individual into contact with a second living tissue, and its attachment by adhesion and nourishment as a parasite, instead of its formation from the original tissue by division, are *necessary*, in order to enable the new individual, after a certain growth and development, to become detached. In this case the involuntary vital function is maintained in the transplanted cell through the membranous walls of the adhering cells or tissues.

Continuously growing tissue may be separated or divided into parts by an external or accidental means, as occurs when the branch of a tree is cut into pieces and the parts thus formed continue to grow as separate individuals by the continuous growth of tissue.

This division of the body into separate parts, each of which develops into a separate individual, is the method of reproduction among some of the lower organisms, such as protozoa, worms, polyps and many plants. It is evident, however, that this method could not obtain in any complex organism, which in the adult state has interdependent parts or organs. The division of such a body would destroy the organism.

## XI.

## PARASITIC REPRODUCTION

The evolution of the organic world in its present condition had its origin in a very simple biological law. The writer does not know or believe that this law has heretofore been recognized, but the proof of its existence is ample. We shall for convenience call it the law of *vital transfusion* or the law of *parasitic reproduction*. It may be stated as follows:

WHEN THE NORMAL SURFACE OF THE MEMBRANOUS WALL OF A LIVING TISSUE OR CELL, PERMEABLE TO THE PLASMA AND IN A MOIST OR MUCOUS CONDITION, IS TRANSPLANTED INTO CONTACT WITH THE NORMAL SURFACE OF THE SIMILAR WALL OF A SIMILAR OR NEARLY SIMILAR PRE-DEVELOPED LIVING BODY, THE TRANSPLANTED BODY OR CELL DEVELOPS AS A PARASITE BY NUTRITION TRANSFUSED TO IT FROM THE PRE-DEVELOPED BODY THROUGH THE ADHERING MEMBRANES, AT THE SAME TIME MAINTAINING ITS SEPARATE INDIVIDUALITY AND FINALLY SEPARATING AGAIN AS A DEVELOPED, SELF-SUSTAINING, INDEPENDENT INDIVIDUAL BY CLEAVAGE ALONG THIS SURFACE OF ADHESION OR TRANSPLANTATION.

Without the aid of this simple and apparently universal biological law the only method of reproduction would be that of continuous growth. The only method of separation of the offspring would be by division of the original growing body or parent into a multiplicity of similar separable parts, each having the potentiality of individual development. This would necessitate a continual degradation of the original parent body to the undeveloped condition of the offspring. There could be no distinction between the adult and the infantile development, as each would alternately change into the other.

If separate organs with special or centralized functions are to exist in the individual offspring, the adult or developed parent having similar organs cannot be divided into parts, each of which is a developed offspring. In order that the adult may divide into a number of separate individual offspring, the adult itself must consist merely of a multiplicity or aggregation of such individual offspring. Therefore, the parent cannot be more highly organized or developed than the offspring.

This method of reproduction by division of the parent could be effective, as already stated, only in the lower forms of living bodies, such as protozoa, plants, worms and polyps, in which there is no marked centralization of function or highly differentiated organic structure.

Even if it were possible for a highly organized offspring to develop by continuous growth out of continuous tissue as a part of the parent, there could be no sharp line of distinction between the old and the new growth, and there would be no method of severing the connection between the offspring and the adult without severing and destroying vital organs, such as veins and arteries, and there would be no agency to perform the separation, which would not be automatic.

For example, the parasitic offspring of every mammalian, until it is set free, is nourished, not by the blood which circulates through the vascular system of the parent, but by its own blood circulating through its own vascular system. The vascular system of the offspring receives nutrition and purification from the vascular system of the parent by transfusion through adhering membranes belonging to the two systems. After the offspring is set free the membranes, being of no further use, separate automatically and that belonging to the offspring dies and breaks away without injury to either parent or offspring. But if the vascular system of the offspring formed an integral part of the vascular system of the parent, the severing and breaking away of the developed offspring, even if there were any means of accomplishing it, would be disastrous, if not fatal, to both parent and offspring.

The reproduction and development of a highly organized living body, capable of later independent separation, must be by this parasitic transfusion of nourishment through adhering membranes. This requires the *transplantation of a living cell or tissue into adhering membranous contact with the membranous tissue of a pre-developed living body* capable of supplying the parasitic offspring with prepared nutrition in liquid form by transfusion through the pores of adhering membranes.

## XII.

## THE EVOLUTION OF SEX

The necessity for the *transplanted living cell*, having a membranous external wall permeable to the plasma and in a moist or mucous condition, made necessary the EVOLUTION OF SEX in nearly all species of animals and plants. There arose the necessity for two different kinds of individuals or SEXES in each species, one adapted to supply the living transplanted cell or tissue, the other adapted to receive, nourish and develop it by transfusion to a self-sustaining condition and finally set it free by recoiling from it along the adhering surface of transplantation.

Even in organisms whose simplicity of structure admits of propagation by extension and division of the parent body, the method of transfusion often has great advantages. Nearly all plants are fixed in position, and if their only method of reproduction were by continuous growth, the separation into individual parts, though possible would be a very difficult process and would seriously interfere with any wide distribution. But reproduction by the parasitic development of seeds, which generally have some means of transportation, enables a single plant to send out thousands of highly-developed offspring capable of making long journeys and withstanding very adverse conditions.

Most plants, on account of their fixed position, are *hermaphroditic*, that is, contain both the transplanting and receiving organs in the same individual, while in most animals these organs develop in separate sexual individuals. In animals the various emotional cognitions called instinct, love and passion are all contributory instrumentalities, which have evolved as adjuncts in the development of the transplantation process. And it is possible, if not probable, that this is the ultimate purpose of all cognitions, all consciousness.

The immobility of most plants necessitates, not only the hermaphroditic proximity of the transplanting and receiving organs, but also the development of gorgeous forms and colors in the corolla and adjacent parts and the production of nectareous and fragrant liquids to attract and induce flying insects to flutter within and scatter the fecundating cells from the anthers over the stigmatic surface. The form of the flower is generally bell-shaped, ear-shaped, or of a more



or less hollow, conical form with internal folds and projections, adapted to cause eddying air currents to perform the same function. In the indian corn the tassel, comprising a cluster of anthers which supply the fecundating cells, is situated at the top of the stalk high above the stigmatic surface terminating the "silk," and, therefore, does not need a color, form or substance attractive to insects. Gravity and the winds are ample agencies to effect the transplantation. In the *Carboniferous Age* there were exceedingly few flying insects and, consequently, no flowering plants, the luxuriant vegetation consisting entirely of cryptogams and conifers.

In the great majority of all plants the agencies of transplantation are purely mechanical, are performed by an external agent and are aided by the hermaphroditic proximity of the stationary organs. The stamens and pistils, or transplanting and receiving organs, are merely modified leaves growing at the end of a branch of arrested development and are in the closest proximity allowed by the plant growth and structure.

In marked contrast with plants, most animals have perfect freedom of locomotion and the power of originating motion within themselves, a power possessed even by the protozoa.

### XIII.

#### THE EVOLUTION OF THE POWER OF COGNITION

Considering now only the more highly organized classes of animals, having interdependent, special organs, in comparison with what may be called the hermaphroditic vegetable world, we find that with this freedom of locomotion comes the simultaneous development of other requirements and tendencies. With freedom of locomotion of the individuals of each sex the hermaphroditic arrangement of both organs in fixed proximity was not a necessity nor even an advantage and, therefore, did not develop in the animal kingdom. With freedom of locomotion in the individuals the assistance of insects and air currents



was neither necessary nor sufficient to accomplish the transplantation of the parasitic cell.

But without these agencies what other agent is to bring about the transplantation? Evidently if the cell is not to be carried by an external agent, the organs themselves must perform the transplantation, either by actual contact or by proxy. But what is there to induce the opposite sexes to approach each other to perform this function? They have freedom of locomotion, but so far no agency to cause them to approach. With no impelling force to make them approach, the natural tendency of all individuals would be, as soon as they are set free, to separate from each other as far as possible, in order that each individual may have as large a territory as possible for food finding. Evidently this arrangement could not develop under the laws of organic evolution without the simultaneous development of some other agency or power of causing the opposite sexes to approach. Any such power or agency, even if it existed, could not operate to bring the opposite sexes together, unless the individuals of each sex could *know* or *recognize* the individuals of the opposite sex.

This necessitates that with the development of individual freedom of locomotion there must also be a simultaneous development or evolution of the power of *cognition*. First of all there must have been the cognition of *self*, or the *consciousness of existence* of self, and then the consciousness of the existence of relations external to self. It was merely a development or evolution of the *irritability* or sensory power known to exist in protoplasm itself—a special development not necessary or useful in general to plants, though in many plants there is a development along similar lines.

For example, in the Orchis Family, comprising about 6000 species, there is the development of a power remarkably analogous to that of cognition, a cognition exactly in this line of sexual selection.\*

But the cognition of self and of external relations and the knowledge of the existence of the opposite sex is not enough to cause the sexes to approach and accomplish the transplantation. There must be an impelling impulse. There must be still another kind of cognition, that of sexual desire, which in animals we call instinct and in man, passion or love.

From this point it is easy to see how the laws of organic evolution have developed this power of protoplasmic irritability into the various other powers of cognition, of emotion and sensation simultaneously

with the development of the special organs of sense—all contributory directly or indirectly to the one ultimate purpose of the transplantation of a living, membranous cell into *parasitic* contact with the membranous wall of a nourishing, pre-developed living body of the same or of a nearly similar species.

This hypothesis of the process of generation or origin of consciousness depends only on the assumption of protoplasmic irritability. While protoplasmic irritability itself has not yet been accounted for, its existence is as well established as the existence of matter or any physical element. This may not be *the* process, which actually occurred in the organic evolution of the phenomenon of consciousness, but it is *a* process which would rationally account for the facts on the assumption stated.

The process of transplantation and transfusion must not be confounded with that of organic *grafting*, which is an entirely different process, operates in a very different manner and produces very different results. In order to make this distinction clear, we may state the law of organic grafting as follows:

WHEN THE FRESHLY SEVERED EDGE OF A LIVING TISSUE, SUFFUSED WITH PLASMA, IS BROUGHT IN CONTACT WITH THE SIMILAR EDGE OF THE SAME OR OF A SIMILAR OR NEARLY SIMILAR LIVING TISSUE, ONE OR BOTH HAVING A SOURCE OF SUPPLY OF NOURISHING PLASMA, THE JOINED EDGES UNITE AND FORM A SINGLE, INSEPARABLE TISSUE, OBLITERATING THE SURFACES OF JUNCTURE AND LEAVING NO SURFACE OF CLEAVAGE ALONG WHICH THERE MIGHT BE A FUTURE SEPARATION.

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\* To be convinced of this one needs only to read the classical researches of Charles Darwin on the "*Fertilization of Orchids by Insects*." In this remarkable family of plants the transplanting cells form a mucous bundle in the shape of a baseball club, the smaller end of which *grasps* the proboscis of an insect when it is thrust into the flower and maintains its hold on the proboscis until the insect transports it into the second flower. While it is being transported from the first to the second flower the "pollinium" or ball club *alters its own form* by bending at a proper angle to strike the stigma when the proboscis is thrust into the second flower. On striking the stigma and completing the transplantation, the pollinium releases its hold on the insect's proboscis.

## XIV.

## DISSOLUTION

One of the essential characteristics of the protoplasmic cell during its period of growth is the flexibility of its walls. When it becomes imbedded in and forms a part of a tissue, its flexibility diminishes along with its activity and utility. These walls are originally formed from material in the plasma or blood by a process of hardening, by which albumen is converted into fibrin and starch and sugar are converted into cellulose. As age increases the cell walls and the tissues composed of them, by this hardening process, as well as by the deposition and accumulation of foreign matter, lose their flexibility and usefulness. The involuntary vital function is retarded and finally ceases. This ends the life of the body and it begins to undergo disintegration. This dissolution or death occurs to every living body in the manner above mentioned, unless it is previously caused by accident or disease.

## XV.

## • CONSCIOUSNESS

The phenomenon of consciousness has already been defined as the cognition or knowledge of the existence of self and of the Universe. The word also defines, as previously stated, a certain state or condition of the brain, in which the brain has this power of cognition of self-existence and of other simultaneous cognitions. This phenomenon occurs only as a property of certain living bodies and is present in them only during certain intervals of time. It is not essential to life and is probably not present at any time in certain species. In most species of plants we have no positive evidence that the conscious state ever exists.

There are at least two different kinds of cognition or knowledge:

1. *Cognitions of external relations*, that is, things external to the brain, or *sensation*. This kind of knowledge comes from correlative internal relations produced in the brain by external relations

through the organs of sense. These correlative internal relations are interpreted by the brain as cognitions of the external relations.

2. *Cognitions of internal relations*: of those relations already existing in the brain and not caused by energy transmitted to the brain and not requiring the aid of sensory tracts or other transmitting organs, but originating entirely in the brain itself, e. g., *memory*.

*Sensation*, or knowledge of external relations, is the fundamental cognition—the foundation on which all other cognitions are built. Without the cognitions of sensation there could be no previous cognition and, therefore, no recollection of a previous cognition. Without sensation and recollection there could be no reason, contemplation, thought or emotion.

There are at least seven different kinds of sensation: sight, hearing, taste, smell, touch, temperature and pressure. It is difficult to conceive of a conscious state existing in any body, which has not experienced any of these sensations.

*Cognitions of internal relations*. These are numerous and we shall not attempt to even mention them all. They may, however, be grouped into three distinct classes, *memory*, *reason* and *emotion*.

*Memory*, or re-cognition, is the cognition of previous cognitions and results from brain activity stimulated or excited by the record in the brain of previous cognitions.

*Reason*, or the cognition of abstract relations, is the same as *thought* or *contemplation*, and includes the cerebral acts of judgment, decision, imagination, deduction, the cognition of future possibilities and many other cognitions—all the result of brain activity stimulated by *cogitation* or the process called *thinking*. It is difficult to state clearly the exact origin of these cognitions and of the brain activity which produces them. To the author they appear to result from brain activity, in which the principal brain stimulus is memory, not of a single, but of numerous previous cognitions, aided generally, but not always, by present sensations.

*Emotion* is cognition of the same general character as reason and appears to originate in the same kind of brain stimuli and brain activity, yet, instead of being characterized by the qualities of reason or thought, emotion seems more exactly to lack these qualities.

Among the principal emotions we may mention: desire, will, impulse, love, hate, rage, sexual passion, sympathy, wonder, admiration, fear, courage, grief, joy, hope and despair.

These various cognitions or varieties of knowledge, are physiological phenomena resulting from cerebral acts—brain activities. They are commonly called “mental” acts or phenomena or activities of the “mind.” We are purposely avoiding in this connection the use of the word, *mind*, because it appears to be unintelligible. Whatever the mind may be, it is *not* the brain, and cognitions are undoubtedly either the acts or phenomena resulting from acts of the brain, or of the brain in conjunction with other parts of the *living* body. There is no doubt that cognitions depend entirely upon the operations of the living body and that they have never been found outside of or apart from the living body. They have never been found except in connection with the activities of a living brain or nervous system. Cognitions are, therefore, as far as we have any evidence in relation to the subject, the result of brain and nervous activity and of nothing else. They are merely physiological phenomena accompanying certain states and conditions of the brain and nervous system of a living body.

The writer confesses that he does not know the meaning of the words, *mind*, *soul*, *spirit* and *faculty*, as commonly used in connection with the phenomenon of cognition, knowledge or consciousness.

We quote the following definitions, which have been given by recognized and celebrated “mental” experts:

*Mind.* The intellectual or rational faculty in man: the understanding; the power that conceives, judges or reasons; also the entire spiritual nature; the soul; that in man which thinks, remembers, reasons, wills, perceives, feels, desires; also memory, remembrance, recollection. These definitions are both material and immaterial, especially immaterial.

*Faculty.* Ability to act or perform; capacity; especially, an original mental power or capacity for the well-known classes of mental activity; psychical or soul capacity; capacity for any of the leading kinds of soul capacity, as knowledge, feeling, volition; intellectual endowment or gift.

*Soul.* The spiritual, rational and immortal part of man which enables him to think, and which renders him a subject of moral government; the seat of life, the sensitive affections and phantasy, exclusive of the voluntary and rational powers; in distinction from mind, the moral and intellectual part of man's nature; the seat of feeling in distinction from intellect; the intellect only; the under-



standing; the seat of knowledge, as distinguished from feeling; a pure or disembodied spirit.

*Spirit.* A disembodied soul; the intellectual, immaterial and immortal part of man; the soul, in distinction from the body in which it resides; the human soul after it has left the body; life, or living substance, considered independently of corporeal existence; an intelligence conceived of apart from any physical organization or embodiment; vital essence, force or energy, as distinct from matter.

It appears from this jumble of the imaginary, hypothetical and concrete that the mind is the soul; that it is energy, force and matter and at the same time not matter; that the soul is the disembodied spirit; that the spirit is the disembodied soul while residing in the body and after leaving the body; that all of these are life, or living substance, considered independently of corporeal existence; that they are all intelligence apart from and in conjunction with physical embodiment; that they are the vital essence; that they are also the brain or thinking part of man: the seat of sensation, life and cognition and the cognitions themselves; that they are knowledge and the seat of knowledge; and that part of man which is immortal.

From these definitions the words defined appear to have no definite meaning and to be expressions denoting the ignorance of one groping in the dark and trying to define what is imagined but not understood—a futile attempt with verbal contradictions to ascribe an immortal personality to an evanescent physiological phenomenon. In defining that which does not exist, it is necessary to create the thing by definition. To define anything as “that part of man which is immortal” is to define it from imagination, because, if any part of man is immortal, it is not possible for us to know it, or to know any of its powers, properties or attributes.

All of these definitions are attempts to define the phenomenon of consciousness and to make of it something more than what it is, the cerebral act and power of cognition.

## XVI.

## THE NERVOUS SYSTEM

Among the various organs comprising certain living bodies there is one of great importance called the *Nervous System*. The entire phenomenon of consciousness, as far as we have any evidence, is a function of the nervous system.

The nervous system in most animals comprises nerves and nerve centers, the former made up of elongated bundles of nerve fibers or rods. Nerves extending from one part of the living body to another act as canals or channels, to transport from one part of the body to another, a certain form of energy, causing certain relations existing at one end to produce correlative relations at the other end. In nearly all bodies having a nervous system the nerves extend from various parts of the body to one or more points of concentration or ganglia—nerve centers. When there is only one main ganglion, it is called the brain, which is the organ of cognition. In vertebrates the organ of cognition is a part of the brain called the cerebrum.

The only living bodies which possess a distinct nervous system are animals, though certain vegetable organisms possess tissues, which unquestionably have the power of transporting a form of energy similar in function to the nervous energy of animals.

In all higher types of animals, especially vertebrates, the nerves all radiate from a single ganglion or brain, which, however, in all vertebrates except in a few species, is divided into two bi-laterally symmetrical hemispheres. The hemispheres are inter-dependent and, acting conjunctively, control the entire nervous system. In many animals of lower classes, instead of a brain controlling the entire nervous system, there is a series of ganglia or nerve centers, distributed with more or less uniformity through the body, each having independent or nearly independent control of a certain portion of the body. These ganglia are generally connected together by nerves into a chain or system.

The nervous system of a vertebrate animal may be accurately compared with the telephone system of a city or country. In this nervous system a single nerve fibre, or *nerve wire*, extends from each point of origin of sensation to the brain, as in the telephone system each wire extends from a transmitter, or point of origin of words, to the central

station, which constitutes the ganglion or brain of the telephone system. Each telephone wire transmits a certain form of energy in impulses of varying length and intensity from the transmitter to the distant receiver, producing in the receiver vibrations correlative with vibrations in the transmitter, the vibrations in the transmitter forwarding the energy impulses along the wire. So also each nerve fiber or nerve wire transports a certain form of energy in impulses of varying length and intensity from the transmitter, or point where sensation originates, that is, from the point of contact of the nerve with the external relations, to the brain, which corresponds to the telephone receiver. In the telephone system the wires are grouped together into bundles called cables. In the nervous system the fibers are grouped together in bundles called nerves. In the telephone system the form of energy transmitted is electrical energy. In the nervous system the form of energy transmitted is not known, because we have not yet been able to isolate it from this particular use or to identify it and study it in other relations. It may also be electrical energy, but we have not yet the means of knowing. The fact that electrical energy has been artificially applied to nerve fibres after death of the body and has produced temporary life in those nerves would indicate the possibility that this nerve energy may be electrical energy and that a nerve fiber acts as an electrical conductor. This hypothesis is further substantiated by the experiments of DuBois-Reymond, in which the nerves and muscles of frogs acted as sources of electromotive force with results as high as 0.075 volt. But until the electrical or other nature of this form of energy is more clearly established, it will be convenient to call it *nerve energy*.

## XVII.

### BRAIN ACTIVITY AND THE CONSCIOUS STATE

The word, consciousness, defines a certain phenomenon of certain living bodies only. We have defined it as knowledge or cognition of the existence of self. Cognition is a more general term than consciousness, designating a class of phenomena to which consciousness

belongs. Cognition is knowledge of the existence of the Universe in general. Consciousness, or cognition of self, is, therefore, a kind of cognition, and is necessarily either the first or one of the earliest of cognitions.

We have no evidence that cognition of any kind ever precedes *sensation*. By sensation we mean the cognition of the transferring of external relations into correlative internal relations within the brain. The mechanism and seat of cognition in higher animals is the brain, but the entire system of nerves is a necessary auxiliary apparatus, because without the nerves no external relations could reach the brain to cause cognitions.

The phenomenon of cognition results from the fulfilment of certain conditions. The brain must be excited or stimulated to a certain kind of activity. A certain kind of transformation and dissipation of energy must take place in the brain as long as any kind of cognition continues. This transformation and dissipation of energy is always accompanied by a corresponding alteration of the brain tissue itself. The exact character of the alteration of tissue depends upon the cognition which produces or accompanies it, and the alteration when produced constitutes a more or less perfect and persistent record of the cognition itself.

We know from experience of only two kinds of brain-stimuli or causes of cognition:

1. Internal relations of matter, energy, space and time produced in the brain through the avenues of sensation by correlative external relations.
2. Internal relations of matter, energy, space and time produced in the brain by the alterations of brain tissue caused by previous cognitions.

There seems to be no power in the brain to originate cognitions until after it has been excited by external relations through sense. We have no evidence to show that any living body ever possessed either cognition or consciousness without previously or at the same time experiencing sensation. We have much evidence tending to show that a being incapable of experiencing sensation is also incapable of cognition or consciousness. In support of these statements we may adduce the following facts:

1. An infant in the womb and immediately after delivery therefrom is always without consciousness or cognition.



2. The cognition of a child developing from infancy are never in advance of the sensations it has experienced.

3. Cognition grows with and is limited by sensation.

4. Without vision or tactile sense there could be no knowledge of form, no knowledge of material limits, no definition within the Universe, no knowledge of space.

5. Without vision, tactile, olfactory, auditory or gustatory sense and without the power of recognizing temperature or stress, no known phenomenon would be capable of cognition.

6. Without these avenues of sensation there could be no knowledge of a past experience, no memory, no knowledge of the relation of a preceding to a succeeding instant or event and, therefore, no knowledge of duration, no knowledge of change in matter or energy—no knowledge of the Universe.

Consciousness is not essential to the existence of any organic or living body; but living bodies are the only ones capable of consciousness. It is probable, however, that some degree of consciousness is possessed at times by the lowest animal and by some vegetable organisms. The sunflower, turning its broad face to the rising sun, the Venus's flytrap, devouring its victim, the diurnal opening and closing of many flowers and leaves all present in different degrees the phenomena of cognition and consciousness, though there is in these lower forms an entire absence of anything resembling nerves.

That the phenomenon of consciousness exists in all animals having *organs of cognition*, that is, *organs of special sense*, such as hearing, sight, smell, taste, touch, there cannot be any question. Otherwise these organs could be of no use and could never have developed. But the evidence that they are used is the same as the evidence of the use of such organs by human beings.

Can there be any doubt that the eyes of a dog enable him to see, that his ears enable him to hear, that his nerves of taste and smell are used in the same manner as those of a human being? Is there any doubt that a dog would howl with pain, if his foot or tongue were to come in contact with boiling water? If not, then there can be no doubt that the dog has cognitions of external relations which are of the same nature as those experienced by human beings. Do not dogs, elephants and other animals prove by their actions that they have memory? If so, they must have cognitions of previous cognitions. Many acts of animals, such as the opening of a door by lifting



a latch, show conclusively that their power of deduction or reason is of the same order and nature as that of human beings. Furthermore, the general anatomical structure of the organs and the functions of the organs in all vertebrates from apes to alligators and fishes, including the brain and entire nervous system, is the same as that of man, differing from man only in the minor details of adaptation to environment.

The belief that animals, even the higher vertebrates, have no consciousness of existence has been especially promulgated by the *idealists*, that is, egotists, the idealist being one who believes that he is the only person and the only thing which exists, and that he himself exists only in his "mind." What his *mind* is he steadfastly refrains from disclosing.

Consciousness, instead of being essential to living bodies, is never even persistent in any living body. It is invariably an intermittent or periodic phenomenon and any tendency toward persistence is generally, if not always, detrimental or destructive to the organism. The average period of consciousness of living animals is about twelve hours, followed normally by an equal period of oblivion, that is, a period in which there is no consciousness or cognition. These periods correspond regularly to a semi-rotational period of the earth. The period of oblivion, or sleep, corresponds in the case of most animals with the semi-rotational period of darkness and low temperature. The probable reason for this correspondence is the fact that during the period of darkness the avenues of visual sensation would be comparatively useless, if that were the period of activity. The operation of the organic law of the survival of those best suited to their environment, has produced races and types of organisms whose requirements in periods of activity and oblivion correspond with earthly conditions.

To this law of intermittent consciousness and oblivion there seems to be no exception among animals, except that the period of oblivion may in some cases be prolonged, either naturally or accidentally, for several days or even months, and in exceptional cases for years, without detriment to the organism. But *the period of normal consciousness cannot in any case be prolonged to any great extent without producing disastrous effects.*

It appears that consciousness, instead of being essential to life, is a phenomenon accompanying only a most destructive or disintegrating condition of the organism. In other words, consciousness is mani-

fested in a living body only when it is in that condition which normally tends most rapidly toward death.

During the period of oblivion or "sleep" there can, of course, be no consciousness. That is, there can be no *unconscious conscious state*. This period of oblivion is the period in which the exhausted brain, the organ of consciousness, rests and undergoes repair.

Dreams, or abnormal conscious states, are usually spoken of as occurring *during sleep*, but such a statement is obviously incorrect. Dreams are abnormal conscious states occurring at intervals between periods of oblivion, or periods of oblivion and normal consciousness, not *during* oblivion. It is evident that no conscious state, however imperfect or abnormal, can be oblivion. Experience has taught everyone to distinguish between oblivion and any variety of conscious state.

There is no evidence that the normal conscious state ever has a continuous existence of more than a few hours. The idea of consciousness, as a being of continuous existence, as a *soul* or *mind*, extending through periods of unconsciousness and returning conscious states, is entirely hypothetical and unsupported by facts. All established facts can be more easily accounted for without than with this hypothesis. An unconscious conscious state is merely a contradiction of terms. We have no evidence that consciousness is anything more than a phenomenon, which accompanies certain juxtapositions of energy, matter, space and time, like the phenomenon of the rising sun or the vanishing twilight.

When consciousness reappears in a living body after a period of oblivion, it is not a continuation of the previous conscious state, but, like the succeeding day on which it appears, is only the recurrence of a *similar* phenomenon. At the end of a day we never speak of the day as going to sleep, and we never think of the day as re-awakening on the morrow, but we always consider that tomorrow will be another day. And so we must correctly consider successive conscious states, not as re-awakenings of a previous conscious state after periods of oblivion, but as entirely new, successive conscious states, each existing for a certain period, then passing out of existence into oblivion.

The notion has gained general currency, and has come down from the remotest antiquity, that the return of consciousness to a living body after sleep or anaesthesia is the awakening of something which maintained a continuous existence in an unconscious state—that consciousness becomes unconscious, yet continues to exist.

We take the ground that no evidence in support of this view can be adduced. The brain, and the brain only, continues to exist during successive conscious and unconscious states, but the separate conscious and unconscious states have no continuous existence. We might with equal reason say that successive waves which roll upon the sea-shore are but successive awakenings of some persistent being, which preserves a continuous existence. Two successive waves washing the same shore may appear exactly alike. Two successive sunbeams shining through a window on successive days may appear to be the same. Two successive flames on the same gas-burner may appear to be the same flame. They are not only not the same; but they have nothing in common, except that they are in the same position. They have the same space-constituent, but entirely different matter-, energy- and time-constituents. Two successive conscious states with an intervening period of oblivion may appear to be exactly alike—and may be alike, though they are not the same.

Both the physical and the conscious identity of every living body is continually changing from day to day, from hour to hour and from second to second. The conscious condition at any instant depends entirely upon the physiological condition. Consciousness accompanies only certain particular conditions of the living body. Destroy the body or the conditions and the conscious state is destroyed; vary the conditions and the conscious state varies with them. With physiological fatigue consciousness is at a low condition. With physiological vigor consciousness is most active. A person retiring after a hard day's labor says "I feel nearly dead," or rising with the morning sun, says "I feel like a new man." Yet he tries to persuade himself that his identity has preserved a continuous existence—that his conscious state was temporarily in an unconscious state.

Is it not more reasonable to say that a new conscious state and a new cognition come with the return of activity to the brain? The previous conscious state and the previous cognition ceased with the cessation of the necessary kind of brain activity. When the brain-tissue again acquires the necessary kind of activity and begins again to dissipate accumulated energy in the required manner, we have no reason to believe that it acquires the *same activity* which it previously exercised, but only an activity similar to that which ceased. We have no reason to suppose that brain activity in itself has a continuous existence with intermittent periods of inactivity. How can activity be

inactivity? We have likewise no reason to believe in the continuous existence of either cognition or consciousness, since they are phenomena of brain activity only.

It is an established and self-evident principle that no event can happen more than once. There cannot possibly be a continuation of a phenomenon after it has ceased to exist. Any phenomenon, after ceasing to exist, may be succeeded by a similar or nearly similar phenomenon, but never can be succeeded by itself.

The fire that burns in a locomotive today and is extinguished at night, is not the same fire that yesterday energized the same locomotive, driving it through the same course, over the same track, though both fires perform the same duties and appear to be identical. There has been an interruption, a time between them when no fire existed. The phenomenon which we call *fire* is persistent through a certain interval of time, but its matter-, energy-, space- and time-constituents are continuously changing. The phenomenon, fire, is persistent as long as the proper conditions obtain, but it is not the same fire in its constituents during any two successive instants. One of the conditions necessary for the existence of fire is the continuous maintenance of a certain minimum temperature. Reduce the temperature below this minimum and the fire, the phenomenon, ceases to exist. While the phenomenon of fire continues to exist the relation between the matter- and the energy-constituents is continuously changing. When the phenomenon ceases the relation between the matter-constituent and the energy-constituent becomes permanent. If, after a certain interval of permanent condition, the temperature be again raised above the critical minimum, the phenomenon of fire is again produced, but not the same phenomenon, not the same fire which previously existed, only a similar fire.

So, likewise, the phenomenon of consciousness which accompanies a certain organism today, and which is really a species of fire, is not the same phenomenon which accompanied the same organism yesterday and passed out of existence, but is only a similar phenomenon.

The brain tissue, containing and constituting the record of experiences, changes but little from day to day. Consequently, each daily succeeding conscious state differs very little from the preceding, and *inherits* or possesses nearly all of the facts of consciousness possessed by the preceding, is at all times an exact reflection of the

record, which exists at the time on the brain tissue, whatever may have been the preceding periods of oblivion or consciousness.

It may be sophistically argued that consciousness has a continuous existence, because the record on the brain tissue is continuous. But the record on the brain tissue is not consciousness. Consciousness is a kind of cognition. A convolution of brain tissue, constituting a record, may be capable of exciting brain activity and producing a certain cognition, but it is not the cognition itself. It is easy to confuse the conception of a phenomenon with that of the physical elements which produce the phenomenon. The printed record of a word in a book is not the word itself. The word is a sound or a combination of sounds. The printed record is only a body capable of producing in the brain, through the organs of vision, a certain cognition, which may cause, through the organs of speech, the production of a certain word corresponding to or correlative with the printed record. Similarly, the brain tissue record of a previous conscious state is not of itself a conscious state, but merely a body capable, through internal relations, without the intervention of organs of sense, of producing or exciting a certain cognition similar to a preceding cognition which produced the record. But when cognition ceases, consciousness, which is only a variety of cognition, must also cease, and cognition of all kinds must cease when brain activity ceases.

All brain activity requires the continuous expenditure or transformation of energy of a certain form. As the store of this form of energy runs low or becomes exhausted, its consumption will stop; cognition will cease; consciousness will cease, though the brain itself may remain substantially unchanged. It is further quite evident that when the brain is destroyed there can be no brain activity, no cognition, no consciousness. Every phenomenon is the result of certain necessary conditions. If one of the necessary conditions is lacking, the phenomenon cannot exist. In this case the transformation or dissipation of a particular form of energy by a particular form and kind of body is an essential condition for the existence of cognition.

The purely hypothetical notion of the continuous existence of a *soul*, *mind* or *individual mentality* was probably born of the desire to live indefinitely. On this theory there was no escape from the conclusion that consciousness must exist in an unconscious state. Whatever theories may be entertained in regard to the existence of a soul or mind, as a thing apart from the conscious state, we leave to



the metaphysician, since it is not subject to *physical* laws, methods or proofs. Consciousness, however, is a truly physical and physiological phenomenon, the existence of which is placed beyond doubt, and it should be investigated by physical methods.

The belief in the continuous existence of consciousness, that is, the existence of unconscious consciousness, and the existence of "spirits," or consciousness apart from any living body, has probably been greatly enhanced and propagated by the vulgar interpretation of the phenomena of dreams and aberrations. Upon the hypothesis that consciousness is an entity, soul or spirit, having a continuous and indefinite existence independent of a living body, dreams, cerebral aberrations, sleep, anæsthesia and death are entirely unaccountable by any rational process. Upon the hypothesis that consciousness is a phenomenon accompanying only certain conditions of matter, energy, space and time, the accounting for all cerebral manifestations comes within the range of possibility, if not probability.

A dream is a phenomenon of the same order as consciousness. It is a kind of consciousness. It is produced under conditions similar to, but not identical with, those which produce ordinary or normal consciousness. In the dream there is cognition, brain activity and the dissipation of nerve energy. There is re-cognition and memory. As there is brain activity, there must be alteration of the brain tissue. There is, therefore, a recording of the phenomenon or dream itself similar to the record of all other conscious states. Consequently, a dream is remembered as a past experience.

The brain activity of a dream, however, is different from the normal brain activity, and the dream is a conscious state excited and maintained while the avenues of sensation are inactive or only partly active. The normal or ordinary conscious state is produced by brain activity while the avenues of sensation are open and active. In the dream the stimulus of brain activity must be entirely or chiefly from within the brain, because there is no normal, voluntary communication through the organs of sense with outer existence. Such a conscious state must be chiefly the product of past and recorded experiences only, or of past experiences juxtaposed upon the imperfect cognitions produced through partly active sensory tracts; but not necessarily or likely of complete or chronologically arranged or relatively connected experiences. They may be fragmentary and jumbled together haphazard, or may follow an orderly chronological sequence.

depending upon the cause and nature of the stimulus of brain activity, and also to a great extent upon the condition and cerebral idiosyncrasies of the individual.

These abnormal brain activities produce cognitions which are merely the haphazard combinations of the most easily available brain records, and the recollection of these cognitions afterward appears grotesque to the normal consciousness.

The writer once dreamed of being introduced to "Mr. Glass," who was entirely nude and whose flesh was transparent. Otherwise he appeared to be an ordinary, living, moving and speaking human being. It is not difficult to understand how this monstrous cognition was produced by abnormal brain activity from the most ordinary of previous cognitions. One of the commonest cognitions is that of the living human form. Another very common cognition is that of glass. The abnormal brain activity, lasting probably only a fraction of a second, worked only on the then most available of previous cognitions, selecting and utilizing only certain prominent characters in each and combining them. In that way the transparency only of the glass was combined with the form only of the human body, the inflexibility of the glass and the opacity of the human body being ignored. In the production of this cognition the abnormal brain activity might also have utilized the record of a cognition occurring twenty-five years before, when the writer had the experience of seeing and minutely examining the bones of his own hand by the transformed Roentgen rays of Edison's fluoroscope.

That a dream may also be a combination of cognitions of memory and cognitions of present external relations, that is, of sensations, is shown by the following experience:

A person was awakened from a dream by repeated calling, each successive call being louder than the preceding. Each call was heard, recognized and answered in the dream, but was not answered in fact. The final call awakened the dreamer and was heard both in the dream and after awakening. The cognitions of the repeated calls must, therefore, have been a part of the dream. These cognitions were caused by external relations through the organs of hearing. From this it follows that dreams are produced at least partly by external relations through sensory organs by involuntary action.

The following quotation from a current daily paper shows another variety of conscious state:

"H. H. R.——, a swimming instructor, arose from bed early to-day, walked to a front second-story window of his home and dived through the glass to the street below. When revived at the hospital he said his last previous recollection was of dreaming he was about to break the world's high-diving record. Attending surgeons said he was not seriously hurt."

This was evidently not a case of somnambulism or sleep-walking, but *dream-walking*, the subject being in a dream and acting in accordance with that abnormal conscious state and under the influence of an abnormal volition. But there is a difference between this abnormal volition and an involuntary action. Permanent or persistent dream-walking is a dangerous form of insanity, causing the subject to commit various acts of violence and unreason while really dreaming that he is doing something else or that his acts are necessary or right. In many cases of this kind the subject has an uncontrollable desire to jump or dive from high places.

An apparently similar, but really very different case was witnessed by the writer. A young lady riding at night on an open street car, having seats extending across from one side of the car to the other, arose from her seat and walked to the opposite side of the car as it approached the street on which she lived. She stepped down on the "running-board," facing forward, as would a person accustomed to alighting from a moving car, and stepped off to the ground. Her manner impressed the writer to a very unusual degree as that of an expert in alighting from moving cars until her foot touched the ground, when she instantly fell forward upon her face. The car was still going about ten miles per hour. It was then found that her act was entirely somnambulistic. She was asleep and entirely unconscious, entirely oblivious, until awakened by striking the ground. Being oblivious at the time of the action, it is evident that the act was involuntary. At the same time, it appears to have been caused by a transfer of external relations into correlative internal relations, which, without producing a cognition, caused the involuntary action. Otherwise why did this act occur at the place where she was accustomed to get off the car?

There is another explanation of this act, which involves less difficulty. The young lady might have been awake and recognized the approach to her street, and might then have fallen asleep. In that case her act was that of ordinary somnambulism. It is not an un-

common occurrence for a person riding in a vehicle to sleep and awaken many times in a minute.

The so-called "mesmeric" state is also probably a variety of dream-acting.

There are well authenticated cases of what is called "dual personality," in which the individual, after years of ordinary life, suddenly loses the entire brain-record and the past life becomes a blank. A new brain-record is then produced, the subject living as another individual for years. Then this second brain-record may be wiped out and the former record may re-appear. The two records may alternately or periodically appear, disappear and re-appear. Some of these cases are also called *aphasia*. In some cases the two personalities may be of entirely different and opposite natures, such as is illustrated in the fictitious case of "Dr. Jeekyll and Mr. Hyde." Sometimes the alternations occur periodically with almost clock-like regularity, especially in certain types of insanity.

There are those who never dream and do not know what a dream is like.

During health there is probably always a small supply of energy stored up and ready at any time for instant use, whenever brain activity may be aroused or stimulated: whenever the organism is awakened from sleep. It is always the physical organism or body that sleeps and rests while it is again being rejuvenated. It is like a locomotive at rest, whose fire has been extinguished while coal is being loaded into the bunker, but whose boiler remains hot with a small supply of steam and is capable of liberating energy and producing activity at any instant.

During sleep and also during dreams the avenues of sensation are inactive or nearly inactive and external relations cannot be transferred into normal correlative internal relations in the brain. Therefore, there can be no correct cognitions or knowledge of external relations under these conditions. Nevertheless, brain activity and conscious states may be stimulated by certain physiological conditions independent of sensation and while these avenues are inactive, such as lack of sufficient oxygen or the presence of a poison in the blood. But the only cognitions possible with inactive sensory tracts are cognitions of the record on the brain tissue itself and those produced by the brain activities stimulated by that record.

While there can be no conscious state without physiological activity



and brain activity, there may be physiological and brain activity without consciousness. During all sleep of the normal organism there is no consciousness, but there is always physiological activity. There are the *involuntary organs*, such as the heart and lungs of vertebrates, which remain active at all times during the life of the body. This action we have already described as the *involuntary vital function*. These involuntary organs act independently of conscious states, normal or abnormal.

Only a small part of our knowledge is from actual cognitions of external relations. A large part of it is inferential. No individual has actual knowledge of the existence of any conscious being except himself. He has cognitions of other living bodies which cognitions come through the various organs of sense. These bodies seem to be similar to his own in form, appearance, powers, attributes and purposes. From these circumstances he infers that these other living bodies are similar to himself and are characterized by conscious states similar to his own. But he does not *know* that there is one other individual having such a conscious state. This is proved by the fact that somnambulists, who are entirely unconscious of their own existence, may walk the streets and not be recognized by us as in any respect different from other persons truly conscious. The writer has known persons intoxicated by alcoholic beverages, who conversed with almost ordinary intelligence and with apparent consciousness of all surroundings and who were able to make their way home at night, passing dangerous places in safety, yet were during all of the time entirely unconscious and on the following day had no recollection of what occurred after a certain moment when the intoxication became complete. Yet on first meeting such a person, though he is entirely unconscious, we have as much reason from his conversation to believe that he is a conscious individual, similar to ourselves, as we ever have to believe that there is in existence any other conscious being besides our individual self.

There are others having *abnormal* conscious states, which are designated as various forms of insanity. Some of these are continuous dreamers: some are in a condition of permanent sleep or oblivion: some live in alternate periods of oblivion and abnormal conscious state. There are also, not only abnormal conscious states, but abnormal oblivious states, such as the intoxicated condition mentioned above, in which the individual, while actually unconscious, appears to



be conscious. These abnormal oblivious states are also varieties of permanent insanity.

The various forms of insanity, or abnormal conscious states, are generally, but not always, recognized by the very fact that they are *not* similar to ourselves. That is why we call them abnormal.

We do not mean that all abnormal conscious states are the cognitions of a diseased brain, though the cognitions of a diseased brain are generally abnormal. By abnormal conscious states we mean those in which the brain activity is not complete, whether the incompleteness is due to cerebral defects or merely to temporary conditions or environment.

In many living animals we recognize evidences of conscious states very similar to our own. In other animals we see evidences of conscious states very different from and inferior to our own. And there are still others, in which the evidence points to the existence of conscious states so low as to be recognizable only with difficulty.

It is not possible for us to know of a previous conscious state which left no record or memory. Therefore, as far as we can have any actual knowledge, the somnambulist, having no memory of his acts, could not have been in a conscious state, but in a state of oblivion.

A dream is an abnormal state produced by some disturbance, either external or internal, which excites activity in a part of the brain, producing imperfect or abnormal cognitions, but not sufficiently strong to excite those centers which control the avenues of sensation and they remain inactive or partly inactive. If the disturbance is very slight, there is only a slight and momentary activity, and there may be only a single past experience, or fragment of an experience, reflected from the cerebral record back upon itself, making an additional, but more or less imperfect, record of the same experience. On the other hand, a sudden and very violent disturbance, such as the report of a gun or a flash of lightning, would excite the most violent activity, causing the entire cerebrum to respond with a sudden vibration of every cell, compelling the cognition thus suddenly evoked to reflect and again record substantially the entire record of a past life in an instant, and before the involuntary or unconscious control of the sensory tracts can be displaced by the voluntary or conscious action, that is, before the entire nervous system can be awakened to acquire a new, normal conscious state.

Thus we may account for those peculiar dreams, in which the

subject, during a severe cerebral struggle, such as a death struggle, or upon a sudden awakening from sleep or from drowning, seems to see his entire life passing instantly before him—seems to live all of the years of his life over again in a fraction of a second of actual time. And it is not improbable that the brain, in its final struggle with dissolution, may, as a rule, if it has not previously undergone serious impairment, reproduce substantially the entire record, and that the final conscious state may be a momentary review of all previous states.

In most cases a dream is the cognition of a confused and jumbled succession of past experiences, irregular, fragmentary and discontinuous. This is because brain activity is normal only when the centers controlling the avenues of sensation are all active and under voluntary control.

Under normal conditions all of the nerve centers are aroused to normal activity by any disturbance with about equal facility, thus evoking a normal conscious state, instead of a dream or abnormal conscious state.

Certain drugs, such as morphine, have the power of keeping the sensory tracts inactive and at the same time stimulating the other centers to activity. This causes a prolonged dream, in which the brain record is *worked* over and over and built up into the most extravagant, grotesque, fascinating and indescribable cognitions. This reckless expenditure of nerve energy entailed by the "opium habit" has a tendency toward obliterating the brain record and rendering it indistinct.

We have referred above to the fact that the period of oblivion or sleep in living bodies may in some cases be extended for months or years without apparent detriment to the living organism. This is well illustrated in the "hibernation" of many animals, in which the animal remains dormant or sleeping during a season of weeks or months. In some of these cases the circulation of blood continues and the involuntary system remains active. That is, the animal continues to live, using up the store of energy laid in as a supply during a season of activity and feeding. At the end of this period of oblivion and involuntary activity the supply of energy—fat—has become exhausted and the animal comes out of oblivion in a lean and hungry condition. This is what occurs in "warm-blooded" hibernators, such as hibernating rodents. In other cases, such as reptiles and

fishes, the blood may actually cease to flow and become frozen solid, so that there is not only oblivion or unconsciousness, but inactivity of the involuntary and all other organs, that is, actual death. This is also true of many, perhaps most, vegetable organisms. Although there is in these cases actual death, there is not necessarily any destruction of the organism, and under other and proper conditions and proper stimulation new life—but not a reawakening of the old—may come again into the organism.

Living bodies may be divided into two general classes, *warm-blooded* and *cold-blooded*. The former have *nerves of temperature*, are able to recognize differences of temperature and are in a normal condition only when the blood or circulating fluid is at a certain temperature or within a certain narrow range of temperatures. Any increase in temperature above the normal produces a diseased condition called *fever*, and any reduction below the normal produces a diseased condition called *chill*.

When in this warm-blooded class the temperature of the blood is increased above or reduced below certain limits, chemical or other changes take place, which produce death and at the same time destroy the organism in such a way that neither consciousness nor life may be again regenerated.

Cold-blooded organisms, including all plants, are those whose blood normally takes the temperature of the surrounding medium. They do not appear to be able to distinguish differences in temperature within certain wide limits, and in most cases suffer no abnormal result or disintegration when the temperature is reduced even below the freezing point of water. Fishes, reptiles and plants are notable examples of this class. The bodies of these animals, as previously stated, are frequently frozen solid, become unconscious, motionless and lifeless: may even be placed in liquid air and their temperature reduced four hundred degrees below zero, becoming as brittle as glass or any inanimate rock. Yet these frozen bodies may again be thawed out and a new life—not the old life—may be brought into them by a revival of the involuntary vital function.

And in this frozen, lifeless state, in which there is no change, no waste or transformation of energy or matter, they might remain through countless eons, having a veritable immortality in the flesh, and yet return again to new life in a new epoch, when the involuntary vital function returns to activity. There are probably at the

present time thousands of such immortal bodies in the frozen Arctic and Antarctic fields of ice, destined possibly, to return in another geologic age. But this immortality is in and of the flesh alone. In these frozen, lifeless bodies there is no more consciousness, no more brain or nerve activity or vital function than in a crystal of marble or quartz. The same is equally true of a grain of wheat or corn. Its involuntary vital function has ceased and it might lie in lifeless immortality of the body while nations and dynasties come into and go out of existence, then finally, with a renewed activity of the vital function, spring triumphant into life and clothe the earth with the verdure of its offspring.

### XVIII.

#### MAINTENANCE OF THE CONSCIOUS STATE

We have already compared the working of the brain and nervous system to that of a telephone system, in which the various parts or organs of the nervous system are structurally and functionally similar to corresponding parts or organs of the telephone system. We have seen that the ultimate purpose of each is the transmission of relations existing at one position in space into correlative relations at another position in space. We have seen that the means or instrument in this transmission is in both cases impulses of energy.

In the telephone system the form of the energy transmitted is electrical energy. In the nervous system, for lack of more definite information of its nature, we have described the form of energy transmitted as *nervous energy*.

The assumption that the nervous system acts in a manner similar to that of a telephone system and that there is a transmission of nervous energy along the nerve fibers similar to the transmission of impulses or waves of electrical energy in the telephone system, is, of course, hypothetical. But the hypothesis seems to be warranted and the explanation afforded by it appears to be more in accordance with all of the facts than any other hypothesis heretofore advanced. Nevertheless, our acceptance of the theory is only tentative.



The operation of the telephone system depends, not only upon its mechanical integrity, but to a much greater degree upon the supply of electrical energy. The mechanical equipment of a telephone system may be faulty and in places or parts defective, yet, the general system or part of it may be operative, if there is the proper supply of electrical energy. But when the battery is exhausted or the dynamo, if one is used, becomes inactive and the supply of electrical energy is cut off, the entire system necessarily ceases to operate. Every transmitter, receiver and wire is dead, and can be again brought into operative or living condition only by a revival of the energy supply.

The same statement is entirely applicable to the nervous system. One or more branches of the nervous system, such as the nerves of an arm or leg, may be cut off, and yet, the balance of the system may be perfectly operative, provided there is a continuous supply of nervous energy.

We come now to an important difference between the two systems. In the telephone system there is no difficulty in maintaining a continuous supply of electrical energy, whether the source of that energy be a dynamo, primary battery or an accumulator. It is not difficult to so arrange the mechanical details that, whatever may happen in the ordinary course of events, there will be no interruption in the supply of electrical energy. This is due in part to the use of duplicate apparatus, always ready to take the place of any part which may give out, and also to the use of practically unlimited sources of energy. In practice telephone systems operate for months and years without interruption.

But in the nervous system of an animal or in man the conditions and the results are entirely different. In the first place there is no duplication of the mechanism which supplies the energy or any part of it. When an essential part of it gives out or becomes exhausted, the system must stop. There is also no inexhaustible supply of energy.

The original source of nervous energy is material supplied by the food. This material enters the blood as a solution and is conveyed by circulation to the brain and other parts of the nervous system. The immediate source of the energy is derived from this material in the blood. Exactly what the substance is, what compound or compounds, by undergoing chemical change, liberate this form of energy, we do not know. We do know in general that the ultimate chemical changes



are catabolic, that is, they are changes of oxidation, or "destructive metabolism," and finally result in the degradation of chemical energy into heat of low degree. But in the transformations which occur, a small portion of the energy passes through the form of nervous energy and becomes available for the operation of the nervous system, just as a portion of the energy of the food ingredients is transformed into muscular energy and becomes available for the operation of the muscular system.

We do not know, however, that the chemical compounds or blood constituents, which produce nervous energy are the same as those which produce muscular and other forms of energy.

We have no evidence that there is any storage or accumulation of nervous energy in the brain or any part of the animal mechanism. The continuity of the conscious state depends upon the continuity of the circulation. A stoppage of the circulation causes an instantaneous extinction of the conscious state.

The particular ingredients of the blood which are necessary to supply nervous energy do not appear to be contained in the food-solutions as they are absorbed into the vascular system from the alimentary canal. These food-solutions consist chiefly of water, albumens, sugars, acids and salts. But in the form and condition in which they are absorbed they appear to supply no nervous energy. The partaking of food appears to have little or no direct effect on the power of maintaining the conscious state, though it generally shows an immediate or rapid effect in reviving muscular energy. The taking of food seems generally to weaken, rather than strengthen, the power of maintaining the conscious state. A person is more likely to feel "sleepy" after eating than before. The exhaustion of the power of cognition and the power of maintaining the conscious state is not prevented by the absorption of nourishment, however frequent or complete the absorption may be. Without the supply of original food-solutions neither the conscious state nor the vital function can be long maintained. But even with this supply in unlimited quantity the conscious state cannot be maintained continuously for any long period of time.

These facts show that the material which directly supplies the nervous energy is not contained in the original food-solution, but is derived from some other direct source. This direct source is in all probability chemical compounds formed from the ingredients of the

food-solutions by organic processes, which take place under special conditions in certain special organs. The special organs are probably the pituitary and the pineal glandular bodies. These bodies are located in the center of the cerebrum and in close proximity and anatomical connection with the inner terminals of the nerves of cognition or special sense. It is also possible, but not probable, that other glands may have some function in this connection.

We could hardly expect the original ingredients of the food-solutions to be capable of liberating nervous energy. A process of that kind would, in fact, almost involve a chemical impossibility.

The importance of the truth of this statement justifies a detailed account of the reasons on which it is based.

It may be stated as a universal principle, that chemical energy, which is a form of static or potential energy, cannot be transformed into any other form, either static or kinetic, without a simultaneous chemical change. Consequently, the chemical change corresponding to any transformation of the chemical energy must occur at the place where the transformation occurs.

Except in cases of dissociation, or splitting up of compounds, which almost always absorb, instead of liberating energy, chemical reactions do not occur without the mutual interaction of at least two or more chemical reagents.

Under all living physiological conditions the physical conditions of temperature, pressure and presence of moisture, are the same in the brain as in the other parts of the body, and it is these physical conditions which determine whether a chemical reaction will take place. Therefore, if the reagents required in the reactions which liberate nervous energy existed as original ingredients in the food-solutions, as they are absorbed from the alimentary canal into the vascular system, these reactions would take place immediately upon absorption, or even in the alimentary canal before absorption. One or both of the necessary reagents would be exhausted before being able to reach the brain. The nervous energy would be produced and lost in transit and not in the brain, where it could be used, or it might not be produced at all.

The conclusion, therefore, seems inevitable that there must be not less than two separate chemical reagents, which directly unite to evolve nervous energy; that they must be separately produced by separate organs; that these reagents, after being formed, must be

separately delivered and brought into reacting contact within the cerebrum and in contact with the cerebral tissue which makes use of the nervous energy.

Hence, we are almost driven to accept the pituitary and pineal glandular bodies as the separate organs, which separately produce the two necessary reagents, they being the only glandular bodies whose position would enable them to perform this function. This hypothesis is substantially supported by the position of these organs in the center of the cerebrum and their anatomical structure and connection with the sensory tracts. The fact that these organs are exceedingly small, weighing only a few grains, is more in favor of the hypothesis than against it, because the actual quantity of energy involved and needed in brain operation, as compared with that involved in muscular operations, is exceedingly minute. The actual quantity of nervous energy required to maintain the conscious state in a human being for a period of twelve hours, if expressed as mechanical energy, would probably be less, possibly very much less, than the millionth part of a horse-power minute.

It is on these grounds that we base the hypothesis that these two small cerebral glandular organs are the factories which produce the chemical reagents whose combination is necessary to evolve the nervous energy which gives to the cerebrum its power of cognition, its power of maintaining the conscious state, its power of using the nervous system as a means of communication for obtaining cognitions or knowledge of external relations, and all of its powers of cogitation, cognition and re-cognition of internal relations. These are the principal, if not the only functions of the cerebrum.

To those who have not given the subject special attention the question naturally arises, Why does not this same argument apply to the development of muscular energy as well as nervous energy, and why are separate chemical reagents not necessary for the production of muscular energy? If so, whence come these separate reagents and how are they separately delivered to all parts of the body where muscular energy is liberated? The same argument does apply with exactly the same force, and we have in the operation of the muscular and circulatory systems a most complete and convincing answer to all of these questions. One of the two necessary chemical reagents for the development of muscular energy is *oxyhaemoglobin*, which is produced in the lungs through the absorption of oxygen by *haemoglobin*,

a certain protied blood-solution contained in transporting receptacles, the red corpuscles of the blood. These corpuscles containing the oxyhaemoglobin are carried by the circulating blood to every part of the body and supply every part of every muscle. In the chemical reaction liberating muscular energy the oxygen is delivered by the haemoglobin and reacts with the second chemical reagent, consisting of albuminous and fibrinous compounds, of which the muscle is constructed. These compounds are also transported to all parts of the body by the blood in the form of solutions, but during transportation they do not come in contact with the oxyhaemoglobin. The de-oxygenized haemoglobin returns to the lungs for another supply of oxygen. It is difficult to conceive a more perfect arrangement for producing and separately transporting two necessary chemical reagents to a body requiring them separately delivered to all of its parts. The flowing stream of one reagent transports the receptacles containing the other reagent, both traveling side by side to every part of the body without touching each other. Then the emptied receptacles, the corpuscles, pick up a part of the refuse, in the form of carbon dioxide, and carry it back to the lungs, from which it is expelled by the respiratory system. All of these transfers of material, the transfer of the oxygen from the air in the lungs to the corpuscles, from the corpuscles to the combining reagent, the transfer of the carbon dioxide to the corpuscles and from the corpuscles to the air-space in the lungs, are accomplished by transfusion through semi-permeable, membranous walls—the transfusion of gases and liquids containing gases in solution. Other products of the reaction which produces muscular energy—products in liquid form—are carried as solution by the stream of blood to the kidneys and other excretory organs, where they also are separated by transfusion through semi-permeable membranous walls from the blood solution and rejected.

Returning now from our digression to the pituitary and pineal organs, these bodies, like many other parts of the living body, like all parts, except the involuntary organs, are unable to operate continuously. The involuntary vital organs, heart, lungs, etc., apparently never tire of their work; never need a period of idleness, in which to recuperate. But this is not true of voluntary organs, processes and functions. It is not true of the power of cognition, of the power of maintaining the conscious state. It is not true of the cerebrum as a voluntary organ.



When the power of cognition has been in continuous operation for a period of from twelve to twenty hours it becomes exhausted, acquires an uncontrollable, involuntary desire to stop, to pass out of existence, and it always does pass out of existence. There seems to be no power that can prevent it. The conscious state may occasionally by extreme stimulation, especially where there is a vigorous physical constitution, be prolonged for a few hours, but finally and in a comparatively short time it always stops. But the brain and body continue to live, now in a condition of oblivion or sleep, there being no knowledge of existence. The involuntary vital function now assumes entire control of the body and sets in operation under involuntary action all processes of rejuvenation and repair in all organs, including the organs which produce the nervous-energy reagents, whether those organs are the pituitary and pineal bodies or not.

Fortunately the involuntary vital function does not surrender its control spontaneously to the voluntary power as soon as the process of repair has made some progress, but continues its hold on the system until the rejuvenation has been completed, and even longer, unless a conscious state is previously aroused or stimulated into existence by an exciting cause.

## XIX.

### THE GENESIS OF THE CONSCIOUS STATE

When after exhaustion the process of regeneration of the physical system or body and brain has been thoroughly or nearly completed, the brain is again in a condition in which it is able to maintain a conscious state, but there is now no conscious state to maintain. The brain still sleeps, if the surrounding space is dark and still and free from all causes of sensation. The brain has the power of cognition, but there is no cognition. Why does the brain continue to sleep after the regenerative processes have been completed? If the brain now has the power of cognition, why is there no cognition?

There can, of course, be no cognition if there is nothing to take cognition of. If there is no light, no wave of visual energy to be transferred, there can be no *transference* into a correlative internal



visual relation and no cognition of vision. If there is no atmospheric vibration, no external wave of auditory energy, there can be no transfer into a correlative internal auditory relation and no cognition of hearing. If there is no external contact with the nerves of touch, there can be no transfer to the brain of a correlative internal relation and no cognition of touch. If the external temperature is the same as the internal, there can be no cognition of an external relation of temperature, no sensation of heat or cold. If there is no external stimulus to affect the olfactory or gustatory nerves, there can be no corresponding transfer into correlative internal relations of, and no cognition of, smell or taste. If there are no external relations of any kind to be transferred to the brain, there can be no correlative internal relations of any kind produced in the brain and, therefore, no cognitions of external relations, no sensations. Hence, the brain must remain inactive, asleep and without cognition, except such cognitions as may originate within the brain.

But if there be no external disturbance to cause a cognition of external relations, what could start the cognition of internal relations or brain records? If such internal relations or brain records could start cognitions at one time without external assistance or stimuli, why not at another time? And why should internal relations, brain records, alone start cognitions at any time? There must always be some kind of stimulus to start any kind of brain activity in an inactive, sleeping brain. Otherwise there would be no reason for brain activity to begin at any particular time. We cannot suppose, we cannot conceive, that time alone, the mere continuity of being, can act as the cause of any change in matter or energy. The hibernating rodent continues to sleep for weeks and months and until there comes a stimulus to an awakenig. This stimulus comes regularly with the season of food supply. It may come in the form of an exhaustion of the animal's supply of fat, of sustaining nourishment. This exhaustion produces a physiological disturbance—probably the sensation of hunger, which notifies the sleeping brain that it is time to awaken.

Under the conditions assumed above, with no effective external relations, no correlative internal relations, there would be no reason, no discoverable cause for the genesis of a conscious state at any time, and our only logical conclusion is that under such conditions there would never be generated another conscious state; that the physical body would continue to sleep as long as these conditions maintained.

We are now confronted with the question of the genesis of the conscious state. How, when and why does it originate? Is the conscious state a voluntary or an involuntary phenomenon? Is the cerebral act of cognition voluntary or involuntary? Is the production of the cerebral condition, in which the brain has the power of cognition, a voluntary or an involuntary act? If these acts are voluntary, whence arise the volition? Volition itself is a cerebral act, a kind of cognition. If the cerebrum is in oblivion, it has no conscious state and, hence, no volition. Therefore, the genesis of a conscious state must be an involuntary cerebral act. We have already seen that neither the brain record alone nor any existing internal relations of the cerebrum at a particular time or at any time, by voluntary or involuntary action, could generate or bring into activity a power of cognition without a stimulus to brain activity. How, then, does it originate?

We have defined the *life* of a body as the period of activity of the involuntary vital function. Therefore, there is at all times during the life of the body the involuntary action of the involuntary vital organs. During the periods of oblivion this involuntary action also absolutely controls the entire system, including even the organs which, during the conscious state, are under the control of volition. The sensory fibers must, therefore, along with all other organs, be subject during oblivion to involuntary action. Of this we have ample evidence in the reflex actions, in which the stimulus of external relations, through the sensory and motor fibers, the spinal cord, the medulla and cerebellum, without any cerebral act or knowledge, causes muscular movement and recoil of the part affected from the contact. The nerve fibers, therefore, both motor and sensory, have the involuntary power of transmitting impulses of energy, but these impulses cannot enter the cerebrum during oblivion. They may knock at the door, but are refused admission while the cerebrum is resting and rejuvenating. But these knockings would of themselves constitute a stimulus to brain activity, and would, if strong enough, cause the door to open and cause the generation of a conscious state.

These involuntary knockings at the door of the cerebrum may occur at any time and would occur whenever there is the stimulus of external relations. And in these involuntary knockings we have, therefore, an ample potential cause for the genesis of conscious states.

But if the cerebrum is not completely or sufficiently rejuvenated

when these knockings come, it will resist their untimely intrusion, will resist throwing off the oblivious state. The knocking must be repeated, continued and must perhaps become louder, more intense. Finally the cerebrum yields and throws off oblivion, perhaps sluggishly, reluctantly, at first, with a successive, instead of a simultaneous awakening of the various sensory powers.. This would cause an initial brain activity, which would be incomplete and abnormal. That is, a momentary dream, an imperfect cognition built largely on the easily available internal relations, brain records, is likely to precede a full awakening to normal conscious activity.

Thus we find that the natural awakening after full and complete rejuvenation of the physical system is generally dreamless, rapid and complete, while an awakening by external disturbance of an incomplete oblivion is very often the culmination of a dream. The dream, in such cases, is probably of very short duration, though it may seem to cover a long period. This momentary dream is really only the initial stage, the incomplete and abnormal stage, of the conscious state which is sluggishly coming into existence and changing from involuntary to voluntary control the muscular, nerve and brain activities.

It follows, therefore, that a conscious state will come into existence as soon as the power of cognition has been completely restored to the cerebrum, because there will always be at least one external relation in transferrable contact with a sensory tract, which is a brain stimulus sufficient to generate a conscious state. That external relation will be the contact of the body with the support on which it necessarily reposes.

There must be first the power of cognition and the power of transmission, then the exciting cause or stimulus, before there can be the generation of a conscious state.

When, after a suitable period of sleep, the cerebrum has again acquired the power of cognition and the power of maintaining the conscious state, it may, nevertheless, and often does, remain asleep for a considerable time, if the surrounding conditions are favorable—if the external relations are those of darkness, quietness and absence of any condition sufficiently stimulating to the sensory terminals. But even under these conditions the necessary contact of the body with the support on which it reposes becomes irksome and irritating to the nerves of touch. There is then an external relation, which is transferred by involuntary nerve transmission into a brain stimulus

and a resulting cognition and conscious state.

A ray of light, the song of a bird, the odor of food or a change of temperature will similarly, under these conditions, become an external relation involuntarily transferable into an internal brain stimulus and cause the so-called awakening, that is, the genesis of a conscious state.

If these are the conditions necessary for the generation of a *normal* conscious state, what are the conditions necessary for the generation of an abnormal conscious state, as, for example, a dream? In this case there must also be the power of cognition, but the cognition is of a different kind. While there is, even in a dream or other abnormal conscious state, a knowledge of the existence of self, it is a very different kind of knowledge from that of the ordinary normal conscious state.

In these abnormal conscious states there are generally lacking most of the prominent features of the normal. There is generally a lack of definition. The space relations and time relations seem to be of no importance. It may seem as easy to step across the sea as over a door-step. It may appear to take only a few seconds to pass from infancy to old age. The chronological sequence of events seems generally of little or no importance. There generally appear to be few if any of the cognitions which we have described as reason and emotion. The power of logical deduction is absent. There is generally little or no fear of death or injury. Frequently there is the sensation of falling from a great height or being subject to other perilous conditions with no injurious results. Perhaps the most notable characteristic of these abnormal cognitions is that they are almost always false and contrary to or at least different from the actual simultaneous external relations.

What, then, are the conditions which determine the genesis of an abnormal, instead of a normal, power of cognition?

Let us suppose that we are led into a room darkened, so that no ray of light enters. We come in contact with an object which seems to be a smooth ball about ten inches in diameter lying in a shallow cavity in the floor. We try to lift it and find it is very heavy and hot, so heavy that we can move it only very slightly. By pushing and lifting we cannot get it out of the cavity. It rolls back in spite of our utmost efforts. From its hard, polished surface, small size and great weight we infer that it is a sphere of exceedingly heavy metal—probably yellow gold. It emits no odor, imparts no taste, but is so hot



that we can endure hand contact with it only a short time. Our cognitions of it come through the sensations of touch, pressure and temperature combined with several re-cognitions. From the sensations of weight and limited size comes the suggested re-cognition of a heavy metal and a solid sphere, also the re-cognition of the particular metal, gold; from gold, the re-cognition of yellow color. Hence, the cognition of this sphere, formed in this darkened room, is that of a solid, heated sphere of polished, yellow gold.

We now open the window and illuminate the room. Instantly we experience an entirely different cognition. We now find that the heavy, heated ball of solid, polished, opaque, yellow gold is only a transparent, hollow sphere of glass, weighing possibly three pounds, attached on the under side to a powerful spring, which allows it to be slightly moved, but not moved out of the shallow cavity in the floor. It is maintained at a high temperature by an internal electric heater connected to wires, which also pass out below.

This hypothetical illustration shows how erroneous a cognition may be, which comes through one, or even three, kinds of sensation, though the brain is in its normal conscious activity. Why did these three perfectly normal sensations of touch, temperature and weight cause this false cognition of a solid, heated sphere of polished, yellow gold? If we had never seen, never lifted, never felt of yellow, polished gold; if we had never felt or seen a spherical or a heated body, would the sensations in this case have caused the same cognition? Undoubtedly not. The cognition was very erroneous, but was, nevertheless, produced by correct sensations of present external relations combined with correct re-cognitions of past experiences and occurred during a perfectly normal conscious state. The past experiences, or at least some of them, were past cognitions of the various properties of gold, cognitions of the form of a sphere, of polished metal, of yellow color and of the sensations produced by high temperature and weight or pressure. These re-cognitions could have come only from the cerebral record, which could consist only of alterations of brain tissue caused by previous cognitions.

What was the result of this combination of correct sensations with correct re-cognitions? The result was a profoundly erroneous cognition—an abnormal cognition. It was an abnormal cognition of the same nature as a dream, but it occurred during a perfectly normal conscious state. And why did this abnormal cognition occur during a normal



conscious state? It occurred because a single avenue of sensation, vision, was closed, because an important cognition or knowledge of the external relations in this case could come only through that avenue. This abnormal cognition was formed from re-cognitions of past events, instead of knowledge of present external relations. Yet, it was undoubtedly the correct, but incomplete, sensations of present external relations, which stimulated the irrelevant re-cognitions into cerebral activity in building up this false, abnormal cognition.

And is this not the key to the genesis of both normal and abnormal conscious states? The normal conscious state is the product of complete voluntary sensation, when all sensory powers are working together, combined with activity of the cerebrum in a normal, rejuvenated condition, capable of properly and simultaneously combining, in chronological order and correct relationship, the re-cognitions of past experiences with the cognitions of present external relations. The abnormal cognitions and conscious states are the defective product of imperfect sensations combined haphazard with re-cognitions of an exhausted or only partly active brain—a brain incapable of coordinating past and present relations; incapable of concentrating brain and nerve activity upon a multiplicity of simultaneous external relations and internal re-cognitions.

In the normal activity the sensory tracts are all simultaneously stimulated, guided and controlled by volition. In the abnormal activity the sensory tracts are partly or wholly controlled by the involuntary vital function and are inactive, except through accidental and generally excessive stimulation. The actual transmission of nervous-energy impulses by sensory nerve fibers is always involuntary. We cannot by volition prevent the sensory nerves from transmitting the impulses caused by external relations. For example, we cannot by volition prevent hearing a sound. But these actions may be guided, stimulated and concentrated by volition. If there are several simultaneous sound relations in progress in a room occupied by a listener, he may by volition concentrate upon the sound from one source, as the voice of one person among many, and not even hear the others. This is what we mean by voluntary control of the organs of sense. There may be many objects in a field of view, but the eye may by volition be directed to only one small object, the others not even being seen.

But there are also conditions under which the sensory nerves do

not appear to transmit external relations, even involuntarily, or, if the transmission occurs, it is entirely without effect. For example, sound relations, though very intense and in close proximity to a sleeper, may be entirely unheard.

These considerations lead us to several important conclusions:

1. That in abnormal conscious states the control of the sensory tracts is involuntary.
2. That in normal states the control of the sensory tracts is chiefly voluntary, but there is always a certain amount of involuntary action.
3. That there may, therefore, be both voluntary and involuntary action at the same time.
4. That there is the possibility of the simultaneous existence in the same individual of an abnormal and a normal conscious state.
5. That the simultaneous existence of the normal and abnormal conscious states, would be most likely to occur, if ever, at the instant when the sensory tracts change from voluntary to involuntary or from involuntary to voluntary action.

When external relations, transmitted by involuntary sensory action, knock for admittance at the door of the sleeping cerebrum and generate a normal brain activity, there may already have been in existence an abnormal conscious state—a dream, caused, either by a previous unsuccessful effort at normal brain stimulation, or by some other cause, and maintained by involuntary control.

In that case there would probably exist for a brief interval, while the change from involuntary to voluntary control is taking place, both the abnormal and the normal conscious states, and both would experience the cognition of the same transmitted external relations, the two conscious states lapping over each other at the end of the abnormal and beginning of the normal.

This would account satisfactorily for the fact frequently reported that, at the instant of a sudden awakening from a dream by a sudden noise or shock, the noise is heard or the shock is felt, both in the dream as it ends and in the normal conscious state at the instant of its beginning. Both conscious states would be in existence during at least a part of the interval covered by the disturbance.

The sound of the sudden closing of a door has caused a dream, in which were reproduced in chronological order the details of events covering a period of years. The slamming of the door, which caused

this dream, was heard in the dream as the report of a gun, which was the final cognition of the dream on the awakening of the sleeper. The same sound was also heard after the dream was over and the sleeper awakened, not as the report of a gun, but as the slamming of the door. The hands of a clock were observed to be in the same position after the awakening as that occupied before the beginning of the sleep, showing that the entire dream and the awakening occupied only a fraction of a minute and possibly only a fraction of a second.

The cerebral operation in this case may be described as follows:

The external relation was an intense atmospheric vibration produced by the door striking its frame. This imparted a strong energy impulse to the auditory nerve. This impulse was transmitted by involuntary action to the cerebrum, where it knocked for admission, stimulating the cerebrum to conscious activity—two kinds of activity:

1. The involuntary act of re-cognition was instantly produced from the ever-present, ever-available cerebral record, and this re-cognition was combined with a cognition of the involuntarily transmitted impulses of the single external relation, that of sound. This single sensation of intense sound, being unassociated with any other simultaneous sensations of external relations, becomes associated with the record of any past cognition of an intense sound, such as the report of a gun, or whatever similar record might be most available. The result is an involuntary, abnormal cognition of a brain record involving the report of a gun.

2. While this involuntary action is going on and producing an abnormal conscious state, the same impulse of transmitted energy, knocking at the door of the cerebrum, which in this case was in an exhausted condition, sluggishly stimulates voluntary activity of all sensory organs and a normal cognition of the external relation of sound.

Thus we have the two simultaneous cognitions and conscious states originating in the same external relation and in the same auditory impulse. One of these cognitions and conscious states was abnormal and entirely under involuntary control, coming into existence and going out again in the fraction of a second, while the control is changing from involuntary to voluntary. The other cognition and conscious state was normal and permanent, but was sluggishly aroused to the necessary complete voluntary activity of all organs of sense.

## XX.

## THE EXODUS OF THE CONSCIOUS STATE

That conscious states have come into existence and that they continue to come into existence, does not appear to be doubted by any great number of people. The manner of, and reasons for, their genesis we have attempted to show. Our final question is as to their exodus. How and why does the conscious state, after coming into existence, pass out of existence? The almost universal belief of mankind is that it never passes out of existence; that it becomes unconscious, but still continues to exist and, therefore, that conscious states and unconscious conscious states are forever multiplying in number.

The easiest solution to this problem would be to join the great majority and admit that the conscious state never passes out of existence, but that is not our solution.

Whenever certain conditions are necessary for the existence or maintenance of anything, the failure of those conditions ends the existence. To admit otherwise is to admit that what is necessary is not necessary, and that what is, is not.

We have seen that the conscious state occurs in the presence of a certain kind of brain or nerve activity and in the presence of the dissipation of a certain form of energy. No evidence has ever been adduced tending to show that a conscious state ever existed otherwise. There has been much *testimony* as to its otherwise existence, but testimony is evidence to the one who testifies, to the one who believes and to no one else. A person might testify that he had witnessed battles waged between human beings on the surface of the moon or Mars. That testimony might be evidence to the testifier and the credulous believer, but to no one else. Aside from this inadmissible kind of evidence none has ever been produced as to the existence of a conscious state outside of a living, active brain.

There being no evidence of the existence of a conscious state outside of a living body, the conclusion is warranted that there is none.

We have already shown that the genesis and maintenance of the conscious state is dependent upon the existence and continuance of certain conditions, the operation of the involuntary vital function. Therefore, when the involuntary vital function ceases to operate, any existing conscious state must cease to exist.

We have defined consciousness as knowledge of the existence of self and of the Universe. We have found that it exists only in connection with brain or nerve activity. Hence, when these activities cease, conscious states will cease.

The phenomenon of water boiling in a kettle on a hot stove depends upon a supply of heat to the water from an external source. Whenever the supply of heat is withdrawn, the boiling ceases automatically. No external agency is required to stop the operation of boiling.

In the same way conscious states cease automatically when there is no longer a supply of what is necessary to maintain them.





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